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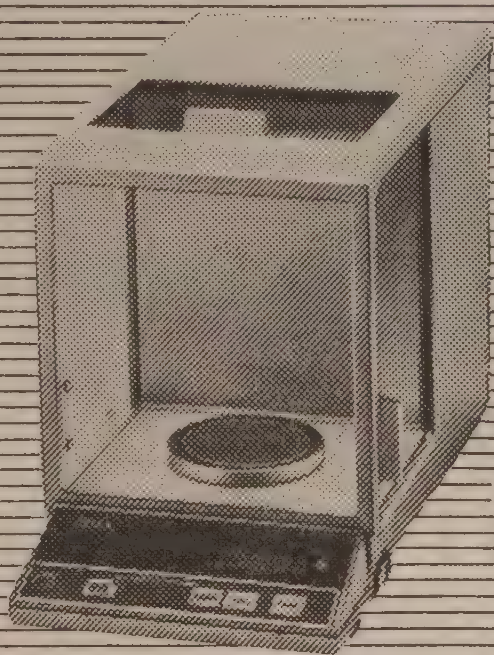

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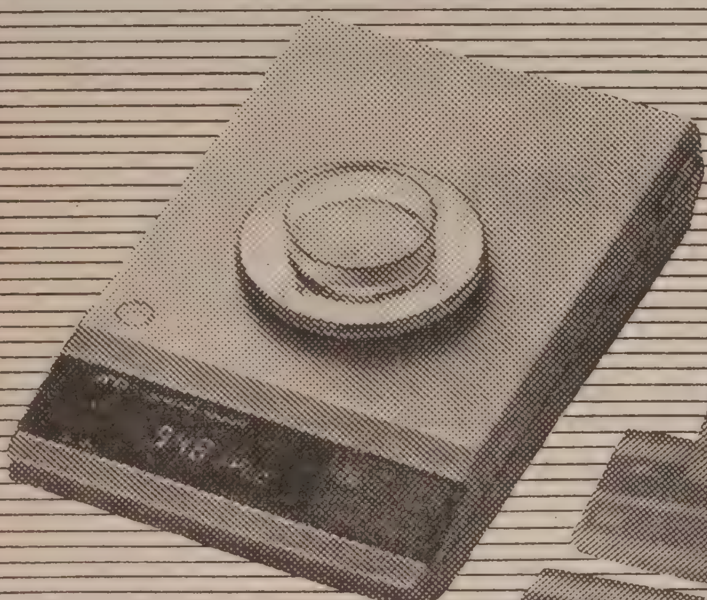

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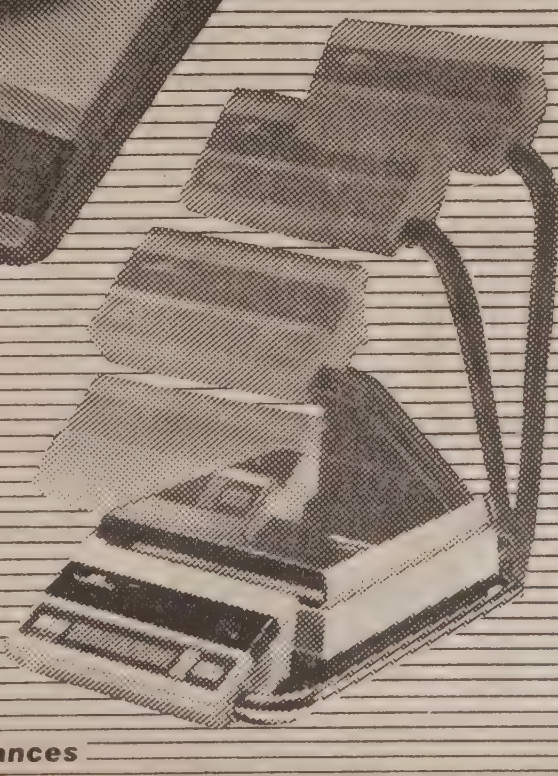

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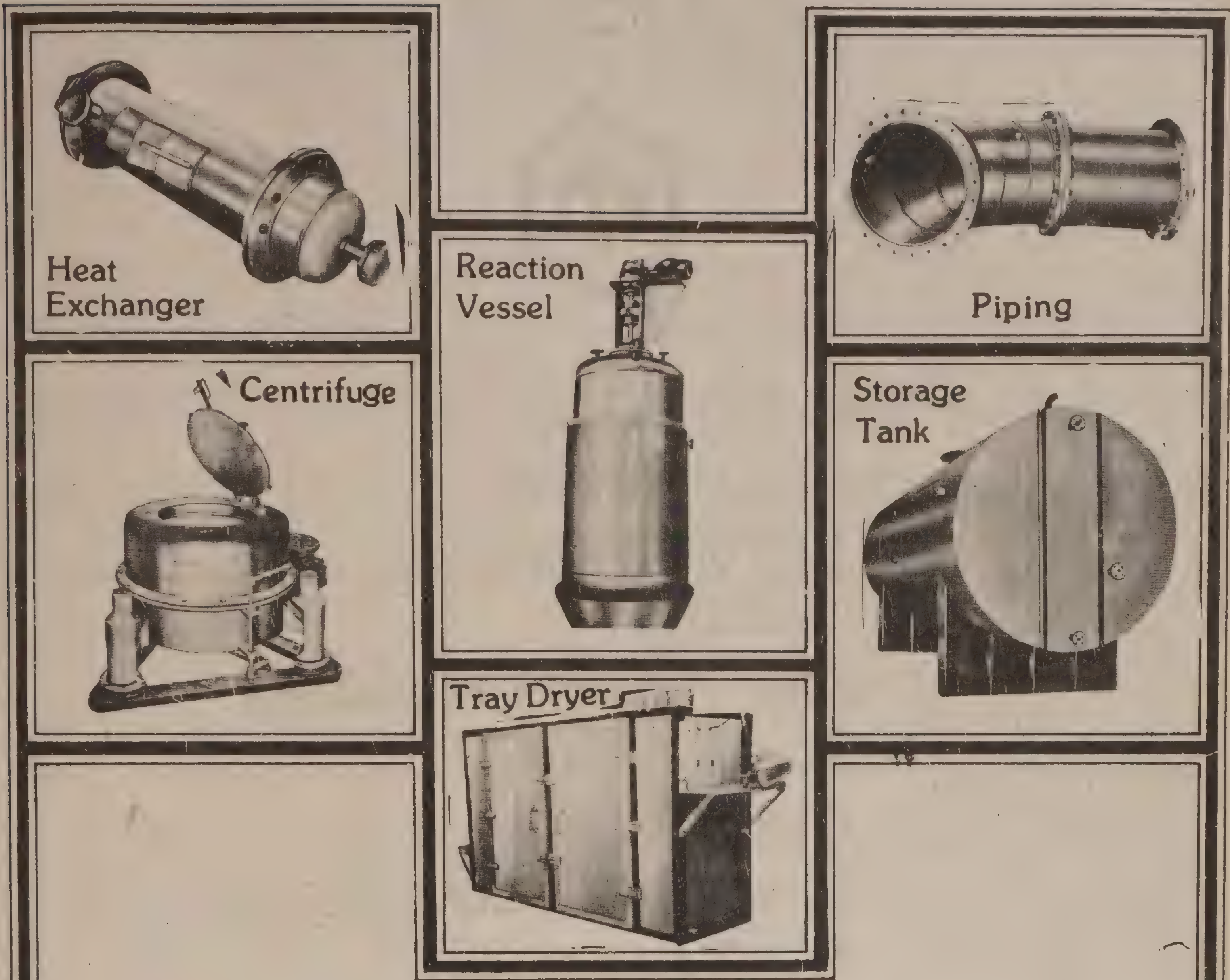
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CHEMICAL WEEKLY

VOL. XXXV OCTOBER 17, 1989 NO. 6

HERALDING THE 21st CENTURY - 29 (a)

Challenges ahead — Will man succeed in unravelling the secrets of the mind and brain?

We have the time-honoured feeling about ourselves that we have a will that is free and that we make choices that emanate from our free will. But in the end, all of that has to come from the brain. It looks possible now that we are going to understand some very basic things about the nature of how our brain works.

Decision making and problem solving may turn out to look much more like the way neural networks function. The neurons in the networks are interacting and interacting — and finally they relax into a stable configuration, and that's your answer. Then, introspectively, we say to ourselves, "Ah, I've decided I will act on these lines".

Now, the puzzle of memory is being solved scientifically by neuroscientists and neural network modelers and understanding memory is the next step. We thought memory was a single kind of process, but we now see that there are probably four of the kinds of ways that memories get stored.

As philosophers and neuroscientists are collaborating as to how they can represent a model of the world in the brain — not only the world of space and time and people but one's own internal world, as well -- your model of yourself as a being that is extended through time, that has a certain personality, that has certain desires and a memory store that can be tapped.

Immanuel Kant made the argument that perception is not likely to be just a passive process — that, in some sense, the brain builds the model of the world; it doesn't just passively receive an image in the way that a piece of film just passively receives an image. So the big questions are: How do brains use representations to make these models of the external and the internal worlds? And what does that mean for how we think of ourselves? The brain does a lot more than think. At the very moment you're deciding which chess piece to move, your brain is regulating your body temperature, making sure you're standing upright, telling you if you're hungry and reacting to the attractive man or woman in the next room.

,And when it comes to fear, anger, love, sadness or any of the other complicated mixtures of feeling and physical response we call emotions, a loose network of lower-brain structures and nerve pathways, called the limbic system, appears to be the key. Researchers stimulating various parts of this system with an electrode can produce strong responses of pleasure, pain or anger. Recent research, indicates that the experience of emotion has less to do with specific locations in the brain and more to do with the complicated circuitry that interconnects them and the patterns of nerve impulses that travel among them.

Researchers have been able to find out the most about primitive emotions such as fear. Seeing a shadow flit across your path in a dimly lit parking lot will trigger a complex series of events. First, sensory receptors in the retina of our eye detect the shadow and instantly translate it into chemical signals that race to your brain. Different parts of the limbic system and higher-brain centres debate the shadow's importance. What is it? Have we encountered something like this before? Is it dangerous? Meanwhile, signals sent by the hypothalamus to the pituitary gland trigger a flood of hormones alerting various parts of your body to the possibility of danger, producing the response called "fight or flight." Rapid pulse, rising blood pressure, dilated pupils and other physiological shifts that prepare you for action. Hormone signals are carried through the blood, a much slower rate than nerve pathways. So even after the danger is past, it takes a few minutes for everything return to normal.

Fear is a relatively uncomplicated emotion; however, sophisticated sentiments — sadness, joy, for example — are much harder to trace. And even primitive feelings such as fear or rage involve complex interactions with the higher parts of the brain — witness our ability to become fearful or angry about an abstract. The mechanics of these interactions are still out of reach, but the same computer models scientists are using now to understand thinking someday may shed light on emotions as well.

Laboratory models of the brain — called neural network, consist of several hundred artificial neurons, whose actions are simulated on a conventional digital computer. A brain researcher at the University of California, uses neural networks to model how the brain processes smell.

Researchers are creating neural networks that show how the brain makes general categories of odours such as cheese or fruit and distinguishes between specific odours such as Swiss or Dutch. Others are modeling the way a casual mention of a particular place or event can evoke a memory of a long-lost friend, how the brain organizes incoming signals from the eyes to give us vision and how neurons rearrange their connections to restore operations after a damaging stroke or in response to a new task. The models are also giving new insights into the dynamic process by which the brain does all these

things. A neuron takes a million times longer to send a signal than a computer switch, yet the brain can recognize a familiar face in less than a second — a feat beyond the ability of the most powerful computer. The brain achieves this speed because, unlike the step-by-step computer, its billions of neurons can all attack the problem simultaneously. The brain's freewheeling, collective style of processing information gives it enormous flexibility and the power to match patterns that are similar but not exact, draw scattered bits of visual data into a cohesive picture and make intuitive leaps.

By simulating these processes in the lab, American researchers are gaining surprising insights into how neural networks and thus perhaps the brain itself—can perform specific tasks. At first, the network responded with a unique pattern of activity for each odour. But as it processed more and more odours that were similar, those neurons that were repeatedly activated became stronger and stronger, eventually dampening the activity of other neurons that were less active.

Biological studies have confirmed how the growing brain of a foetus lays down its neural circuity. New studies have shown that, even though much of the brain's wiring is laid down in the womb, the connections between neurons can also be rearranged during adulthood. More substantial rearrangements are believed to occur in stroke victims who lose and then regain control of a limb.

The biggest impact of neural networks may be in helping researchers explore how the brain does sophisticated information processing. Even though scientists can record signals from the individual neurons in the brain that might be involved in such a task as tracking an object with the eyes, they still don't know how the brain puts those millions of signals together to perform the computation. But because a neural network can adapt its connections in response to its experiences, it can be trained to learn sophisticated brainlike tasks — and then researchers can examine the artificial brain to get clues as to how a real brain might be doing it.

A new technique, called magnetoencephalography, or MEG, is the key to a medical advance that was virtually undreamed of only a few years ago: The ability to observe the functioning of the living brain, to tell where it is processing signals and whether its activities are normal or unusual. This is different from observing the brain's form or structure.

The basis for this advance, in turn, is that the brain produces extremely weak but detectable magnetic fields, which are not distorted by the skull or nearby tissues. Their detection thus can clearly show which part of the brain is active, or how it responds to a stimulus such as a sound or flash of light. Detecting these fields is difficult. It calls for the most advanced magnetometers, which rely on superconducting circuits cooled with liquid helium. But today, in a number of American laboratories, the needed instruments are in daily operation. The study of neural magnetism has rapidly come to the forefront of research on the brain. And medical researchers, in turn, hope to use this approach to develop new and basic insights into a host of disorders: epilepsy, stroke, Alzheimer's disease, coma, spinal-cord injuries — even migraine headaches and learning disabilities.

The idea that there are magnetic fields within the human body and brain and that they can be detected and made to serve medically useful purposes dates only to the last decade or so. Why should the brain produce such fields? The answer lies in the way a neuron, or nerve cell, works. It produces an electric current not as a flow of electrons, as in ordinary wires, but as a stream of electrically charged sodium and potassium ions. This flow of ions produces a magnetic field, as would a current of electrons. However, the field is weak. Typically, it is only one-thousand-millionth as strong as Earth's own field.

The new technique of magnetoencephalography promises to become as important and critical a diagnostic tool to psychiatry and neurology as are X-ray images to internal medicine, or the microscope to pathology. Epilepsy was a natural problem for the new instrument. As early as 1977, other researchers had shown that epileptic seizures produce magnetic fields several times stronger han those of the normal brain and thus would be particularly straightforward to study. "Epilepsy has been aptly described as an electrical storm in the brain," says Barth. "Neurons, brain cells, are linked together in networks. Their normal activity is mediated by neurotransmitters, substances that activate or inhibit individual neurons." These are molecules whose presence in minute quantities turns the neurons on or off. Depending on where in the brain they occur, these discharges can lead to a patient losing contact with the world, sitting with a glassy stare, or epileptic seizures.

One method of investigating the brain is electroencephalography, or EEG. It relies on measurements of the electric currents produced by the brain, and has been in use since 1929. Thus, to locate the source of an epileptic's seizures, a standard technique had been to place electrodes directly on the brain during surgery — ten or 15 of them in a line — and then move them across the brain to map the organ's activity. This success in studies of epilepsy has given encouragement to other researchers who are working on more difficult problems. Dr. Bloom and Dr. Christopher Gallen are seeking to produce activity in the cerebral cortex, the outer layer of the brain. The hope is to develop a working understanding of the normal brain activity, then detect abnormalities by comparison.

"We're studying narcolepsy," "It is a disease where people will be walking along, then just go to sleep without warning. People become limp and fall to the ground like bricks. We're trying to find which parts of the cortex turn off as they fall asleep. That's an example of using MEG creatively — to see where the black-out begins."

Gallen also is seeking to detect changes in brain produced by Alzheimer's disease. Today there is no clear diagnosis of this illness. Often a doctor can give a sure diagnosis after the patient has died and the brain has had an autopsy with MEG, however, Gallen hopes to be able to detect Alzheimer's disease in its early stages. Dr. Flynn is using MEG to study coma. His hope is "to look at a comatose patient and actually measure responses having to do with thinking — not just reflexes."

MEG has also given new insights into the ordinary processes of mental activity. Gallen, at the Scripps Clinic, points out that tones heard by the ear are processed within a region of the cerebral cortex called the Heschis gyrus. Tones of different pitch or frequency produce brain signals at measurably different locations at the Heschis gyrus. While the secrets behind the functioning of the brain may be unravelled in the coming decades, the most formidable challenge before man is to understand the vital role of the brain in the storage and retrieval of memory and the development of aptitude for specific information in individual and the "stuff" the dreams are made of and finally turn the brain shapes each man's mind.

—T.P.S. RAJAN.

(Source: (i) The Mind in motion by Geoffrey Montgomery, *Discovery*, March 1989. (ii) Our Wonderous Brain—William Allman, *Span*, September 1989.

CHEMARENA

S.L. VENKITESWARAN

Improved Nickel Catalysts

A new line of nickel catalysts of higher activity at lower nickel content has been developed by Unilever Specialty Chemicals and are termed HTC hydrogenation catalysts. This is claimed to be a major development since several years. Unilever states that the major improvement is on the carrier or support. Instead of a precipitation technique, usually from nickel formate the new method uses a specially engineered alumina support with controlled pore size distribution. This provides for greater dispersion and more accessible nickel surface which can be designed for varying feedstock conditions. The comparative data on HTC catalysts and conventional ones shows nearly half the nickel crystal size and only 30% of nickel content with over double the nickel surface area per gram of catalyst.

The application envisaged are for dearomatisation of a wide range of solvents, hydrogenation of pyrolysis gasoline from naphtha cracking and related areas. The catalysts are highly stable and active at lower temperatures as well. The catalysts are to be produced in UK and be marketed soon. Capacity increase in existing units through changeover is also possible.

Aramids moving into high gear

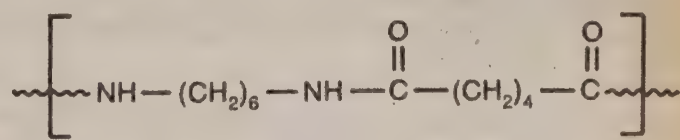
Kevlar and *Nomex* fibres are the recent development from DuPont and are set to hit high volume markets. The growth of *Kevlar*, the more promising material has been at 20% a year even though it is high priced while *Nomex* is a speciality fibre — for flameproof clothing, hot gas filtration, insulating material, dry transformers. Also *Nomex* can be fabricated into mechanical paper in honeycomb fashion and covered with a reinforcement such as glass fibre or *Kevlar* for use as structural heat resistant buildings. The production of *Kevlar* is moving into the 100 million pounds range.

Kevlar hit the headlines as the material of very high strength to weight ratio used for the Gossamer Albatros, human pedalled craft to fly across the English Channel. It is also more widely known as the material for bullet proof vests now used in ever increasing numbers and it is also preferred as reinforcement material for aircraft, boats and may move into automobile components. Weight savings for required performance is the main driving force for its growth but even so use for tyre reinforcement is difficult due to costs. One estimate is that *Kevlar* saves 20 lbs. per truck tyre and for one of the behemoths on the road the saving in weight is 360 lbs, so much more pay load per trip. *Kevlar* as a fibre for mooring lines is very attractive as a 3'' cable has the break strength 30 times that of 3'' steel cable and weighs only 4 lbs. per foot as against 30 lbs. for steel.

Polyester fibres have a strength of 10gm. per denier, 2 to 4 times of cellulosics but theoretically 10 times more could be possible if the chain is ideally oriented. Only the aromatic structures provide the stiffness with orientation and stability at higher melt temperatures. *Nomex* is based on meta dicarboxylic acid (isophthalic) but is difficult to align while *Kevlar* with the para dicarboxylic structure is ideal. It has to be extruded from a sulfuric acid solution under very precise conditions and needs a special proprietory solvent for making the polymer. The comparative structures of polyamide 66 and *Nomex* and *Kevlar* are in Figure. DuPont's supremacy in the technology was disputed by claims of similar

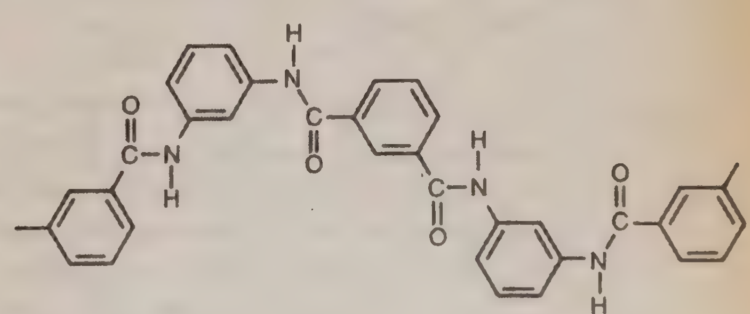
Nylon 6,6

Aliphatic nylon structure is difficult to align, can tangle and weaken



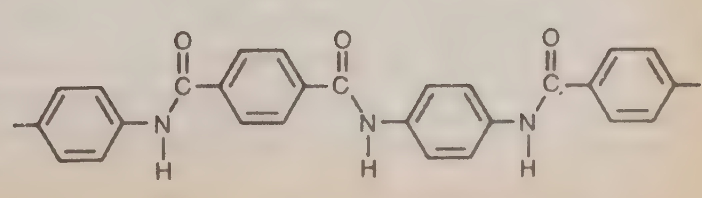
Nomex aramid

Nomex aramid locks in greater stability because of aromatic rings. But meta chain extension still hinders unidirectional alignment



Kevlar aramid

Kevlar aramid structure features para chain extension, forming stiff molecule that can be oriented



material to *Kevlar* from Enka of Holland and Enka has been absolved of patent infringement in Europe. Enka is now marketing the material under the name *Arenka* and actively canvassing for use as tyre cord in place of steel belting of higher weight. When there is a meeting point on price and performance, the use of aramid *Kevlar* could jump. Enka could provide the competitive edge to step up usage of the aramids. The intermediates for both *Kevlar* and *nomex* are difficult and high cost ones — the acid chlorides of the isophthalic and terephthalic acids have to be used along with the meta or para phenylene diamines respectively. There could be a breakthrough in the intermediates if the need for acid chlorides could be avoided and a cheaper way to stable para phenylene diamine worked out.

Ethylene directly from Methane

Methane, the major component of natural gas is in relative plenty in India while petroleum needs to be imported to meet nearly half of our needs. An attempt to convert methane to liquid fuels of middle range via methanol was referred to earlier in these columns. Methanol can also be converted into ethanol or ethylene by recent process developments. But it is the direct conversion of methane without the costly indirect route which holds more promise. There is at last a breakthrough in this so far as ethylene production is concerned.

'Oxidative coupling' of methane to ethylene in one step using metal oxide catalysts with high selectivity has been reported by Arco. Special promoters are used — sodium pyrophosphate is mentioned and also some stabiliser. It is not catalytic in the real sense for the oxide abstracts the hydrogen and then has to be oxidised back separately. A design of fluidised bed reactor with a reoxidation cycle —like the Fluid Bed Cracker of petroleum refineries is envisaged and much work is ahead before commercial debut.

The economics of producing ethylene in this manner looks attractive and on methane priced at 50 cents per million Btu., the costs are expected at 25 cents a lb. of ethylene — in line with present prices. In terms of parity with oil price, crude oil at $25 per barrel is mentioned -- the same as for MTG.

As mentioned earlier the question is not merely one of price parity but of having ethylene from sources other than by naphtha or ethane cracking. It is well-known that much emphasis is on the C-one chemistry towards petrochemicals. Ethylene, the gateway to many petrochemicals if derived directly from methane can be an outstanding breakthrough. Ethane gets cracked to ethylene but using methane opens out better prospects as methane is the major component of natural gas. It is understood that some ethane and propylene are also formed in the process but whether they are significant or can be made coproducts is not known.

Growth in Unsaturated Polyesters

Thermosets, particularly the polyester resins have returned to growth upward since 1988 and at a level higher than the GDP rates in USA. Improved products, automated use of the resins, a range of reinforcement materials and improved processing systems have helped the revival. Particular mention should be made of ultra-fast-curing of sheet molding compounds for autobody parts.

Dibasic acids and polyols along with styrene (for the unsaturated part) are the basic intermediates and there is scope for a variety of products tailored for specific uses through the change of reactants which also provides opportunity to control costs. Phthalic anhydride, maleic anhydride, isophthalic and terephthalic acids are the backbone and propylene glycols the more widely used alcohols. Newer polyols like neopentyl glycol help to introduce special properties. Bisphenol A and propylene oxide are reacted to give a glycol which is then reacted with an unsaturated acid to give a better resin. There is scope for a variety of speciality resins for high performance (at higher costs). The curing is done in a solution of unsaturated monomer using a catalyst or initiator. Fillers are added before the cure and can vary from cheap inorganics like calcium carbonate and alumina to chopped fibreglass or continuous strand mats or carbon fibres.

The fabrication methods have advanced from open mold hand spraying to the semi automatic processes such as RTM — resin transfer moldings and now "pultrusion". This refers to the compounded mix with catalyst being pulled through a shaped orifice in a heated die when curing is completed during the passage through the die. Labour intensive processing and fabrication methods have given way to automated systems that use computer aided designs, RTM, pultrusion, etc. SMC systems enable the competitive production of automobile parts. SMC can be in sandwiched flat sheets for pressing. The transition from the base resins to the fabricated parts is by various alternatives depending on end-product and the volume of demand. An all purpose van with the entire body in plastics, mostly of polyester is expected to make its appearance soon and expected to use 300 lbs. of reinforced plastics of which 70 lbs will be the resin. The use over the recent years has grown from 1000 million lbs in 1982 to 1400 million lbs. by 1984 and stayed near this level before the present growth cycle. (*CHEMICAL BUSINESS*, June 1989)

PROCESS PLANT AND MACHINERY ASSOCIATION SEMINAR:

Review of sales tax act urged

A favourable review of the sales tax rules, with particular reference to provisions pertaining to the works contracts, was urged by Mr. K.P. Mohandas Rao in his welcome address at the one day seminar on 'Projects and their implementation' organised by the Process Plant and Machinery Association of India, in Bombay on September 22.

Mr. Rao, who is the Chairman of the association urged the Chief Guest, Mr. Sushil Kumar Shinha, Minister for Finance, Planning and Employment Guarantee Scheme, Government of Maharashtra, to favourably consider the views of the Association. In his welcome address he said:

"The Process Plant and Machinery Association of India is in its adolescent stage, having survived through a quarter century when the Process Plant Manufacturing Industry faced several problems. The Association embraces in its membership Engineering Consultants, Design Engineering Companies, Manufacturers of Process Plant and equipment, contractors, inspection, erection and commissioning organisations numbering about 110. "During the past quarter century, the Association has been looking after the interests of its members as well as the interests of the nation in bringing into existence many organisations which are vital to the nation's progress.

"The theme of the Seminar has been selected to focus the various problems faced by the industry for which corrective measures have to be taken by those in authority, The Process Plant manufacturing industry is poised for greater roles in the coming decade and it is expected that the Seminar will highlight some of the major problems faced by the members. What remedial measures are required? Given the opportunity the industry could stand upto the expectations of the Government in fulfilling its ideals. The papers will highlight how much planning has to be taken at the conceptual stage of a project itself to make it successful with the resources and time allotted to it.

"To you, Sir, we would like place one or two points for consideration of the State Government. The present position of the points mentioned below focus pointed attention as to how the local industries of this sector of Maharastra are adversely affected.

Mr. Shushil Kumar Shinde, Maharashtra's Finance Minister, addressing the members of PPMAL

Sales Tax:

"In Maharashtra Sales Tax on Works Contract is charged at 4% on the entire Works Contract value without giving any deduction on labour. The Supreme Court, in a recent judgement, has ruled that charging tax on the entire value of the contract without deduction on labour is not permitted. Accordingly, the Sales Tax Act on Works Contract in Maharashtra is being amended. On this aspect there are two suggestions:

a) As you are aware, in a Works Contract sometimes it is difficult to segregate the value of goods and labour. Hence the State should give an option to the tax payer to pay composition money at 2% on entire receipt of the Works Contract, a facility similar to what has been given by our neighbouring State of Gujarat. This would help the State to avoid a lot of litigation.

b)Since the Supreme Court has ruled that the State has no constitutional right to levy sales tax on entire receipt of contract, our clients are not reimbursing the tax, but we have to pay the tax on our turnover every month. To avoid this ambiguity in the law and harrassment, the State should amend their law as early as possible or issue an administrative circular in the interim period to clarify the position.

"Sales tax is the principal indirect tax collected by all the States. A nine member committee of Commercial Tax Commissioners set up by the Central Government has already identified 29 commodities of mass consumption in respect of which the rate of sales tax should be more or less uniform. In Maharashtra, considering the levy of additional sales tax, surcharge, octroi and the high rate of sales tax on certain

commodities of the industry is already in disparity on this account with the industry in other neighbouring States. To avoid the shifting of such industries or other activities in other States, the Maharashtra State should revise the rates of their sales tax on commodities of mass consumption.

"The Maharashtra State had already agreed, in principle, to replace octroi duty with entry tax, but due to pressure from the Municipal Corporation of the State, the decision is postponed. The State should not agree to such pressure. It should immediately abolish octroi duty and introduce entry tax in its place to relieve the industry from the hassle of paying duty at each checkpost.

"I am sure the Honourable Minister is fully aware of the impact of the heavy burden of taxes on this vital industry and the need to encourage its growth to ensure greater employment opportunities and prevent the tendency of the industries to shift to other States.

The inaugural session was followed by the technical session chaired by Mr. H.S. Kohli, Director (operations) KRIBHCO. Three papers were presented in this session.

The first paper presented by Mr. A.V. Basole dealt with the new projects in the coming decade. The paper concluded that the forthcoming decade would see business worth Rs. 7,500 coming the way of the Process Plant Industry.

In addition to the refinery, fertiliser and petrochemical sectors substantial opportunities will arise from the requirements of ONGC, the nuclear industry, space research and defence production. The next decade would thus offer an excellent opportunity for the industry to achieve an annual turnover of about Rs. 1,300 crores a year as compared to Rs. 700 crores at present.

The second paper titled "Tackling Project delays on war footing-vital for the nineties", presented by Shri P.G. Bhadankar, Director PPMAI, highlighted the fact that the economic viability of the mega projects in the pipeline signed on their completion within the scheduled constraints of time, money and technical manpower. The paper noted that a study of 297 projects, during the last 10 years, each costing more than Rs. 20 crores, have revealed a cost over-run of an astonishing Rs. 29,300 crores.

The third paper titled "A successful project completion report" presented by Mr. Pothen Paul, Associate Director -Operations, Davy Powergas I P. Ltd. related the important factors that contribute to a successful project.

The paper concluded that managerial strength, initiative, motivation and detail planning and monitoring of work can go a long way in successful implementation of a project.

Ramesh Hariani elected Chairman: Mr. Ramesh Hariani was recently elected Chairman, Process Plant and Machinery Association of India. A graduate in Mechanical Engineering, City University, London, he also holds an M.B.A. from Bradford University, Yorkshire.

Mr. Ramesh Hariani

After an intensive on-the-job stint in the U.K., he returned to India in 1977, to take over as Technical Director, G.R. Engineering Works Ltd.

STATE-OF-THE-ART — SYMPOSIUM ON TREATMENT OPTIONS SUGAR, DISTILLERY, PAPER & ALLIED INDUSTRIES

Centre for Environmental Science and Engineering, Indian Institute of Technology, Bombay is organising a Two-Day "State of The Art" Symposium on treatment options currently available to tackle the pollution problems of sugar, distillery, paper and allied industries on December 7-8, 1989 at IIT, Bombay, as a self supporting activity with the co-sponsorship of IDBI, ICICI and industries.

Several treatment methodologies have been adopted and implemented by distillery units. Technology is now available for the effective management of pollution problems of large and mini paper mills. Advances in anaerobic-aerobic, concentration-incineration and membrane methods besides process improvements can be integrated to evolve an optimum energy-efficient flow-sheet to achieve the stipulated limits with resource recovery/conservation potentials and also reclaim water for reuse by upgradation.

The symposium will provide a platform for the dissemination of available technology sources, in-house developments, adaptive technology and know-how from foreign collaborations, case histories of prototype installations as well as emerging technologies and developments ready for commercialisation. We expect an audience of 125-150 representatives from industries, consultancy, regulatory, financial and Governmental agencies as well as technology/equipment suppliers and leading institutions.

Papers will be presented by senior executives representing equipment manufacturers, industries engaged in the production of sugar, alcohol, paper and allied products/operations, consultancy organisations and financial institutions.

Novel Technologies/Systems:

1. Anaerobic biotechnology & biogas generation.
2. Aerobic treatment with oxygen rich air.
3. Incineration of high strength waste-waters.4. Recovery of energy/valuables.
5. Composting of distillery waste.
6. Integrated wastewater treatment: Sugar-distillery-paper.
7. Process retrofits/modifications.

Technical sessions (Tentative):

1. Theme Papers
2. Anaerobic processes - I (Distillery)
3. Anaerobic processes - II (Paper & Allied Industries)
4. Combustion processes (Distillery, paper)
5. Aerobic/integrated treatment systems (Paper)
6. Technical collaborations, project financing & management
7. Challenges, damands and emerging technologies

For more details contact: Prof. H. Veeramani, Symposium Chairman, Centre for Environmental Science and Engineering, Indian Institute of Technology, Powai, Bombay-400 076. Phones: 5143509, 5141421-Ext-3251, Telex: 011-71385 IITB IN, Gram: "Technology".

BENGAL'S RABI ALLOCATION CUT

West Bengal has been allocated less fertiliser for the current rabi season (October-March 1989-90) compared to the consumption in the last rabi season (October-March 1988-89). The state has been allocated 225,000 tonnes of nitrogenous fertilisers (N), which is six per cent less than the last season's consumption of 241,000 tonnes. The cut in the allocation of phosphatic fertilisers (P) has been marginal, barely two per cent, the current allocation being 105,000 tonnes against last season's consumption of 107,000 tonnes. The allocation of potash (K) at 68,600 tonnes is almost the same as last year's consumption.

The allocations of N and P have been slashed despite the growth in consumption of these two nutrients in the state in the last rabi season over October-March 1987-88. Thus, in the last rabi season, the growth in the consumption of N over the 1987-88 season was five per cent and that of P was 22%. In the case of K, the consumption was up by 23 per cent the overall growth being 12 per cent.

At the meeting held in Patna, West Bengal officials reacted sharply to the cut in allocation. They said the cut was unwarranted as there had been a steady growth in the consumption of fertilisers in the state in the past few seasons. The officials of the ministry of agriculture attending the meeting assured that there was no need for panic as the centre would make additional allocations when the situation arose.

The allocations in respect of other eastern states, however, show an improvement over the consumption in the last rabi. The biggest beneficiary has been Assam. For the current rabi, Assam has been allocated 11,250 tonnes of N, a 68% improvement over the last rabi season's consumption of 6,700 tonnes; 5,500 tonnes of P (a 62% rise); and 5,000 tonnes of K (a 61% rise).

Bihar has been allocated 24,300 tonnes of N; 89,500 tonnes of P; and 40,000 tonnes of K. The consumption growth in the last rabi over the previous rabi was as follows: 14% rise in respect of N; and 24% in rise in respect of P and K. The overall improvement was 18%. The allocations for Orissa have been like this: 54,500 tonnes of N, jump of eight per cent; 21,500 tonnes of P, a marginal drop; and 18,840 tonnes of K against 15,000 tonnes or a rise of about 25%. The consumption growth in the last rabi over the previous rabi has been as follows: 11% for N; 9 per cent for KP; and 16% for K. The overall improvement was 12%.

Purchase And Sales Exchange completes 34 years

M/s. Purchase & Sales Exchange, one of the oldest trading houses of chemicals in Bombay, has completed thirty-four years of yeoman service to the chemical industries, on 10th October 1989 'Dassara' day.

Mr. Tejkumar Dikshit

Started by the Staunch Gandhian and nationalist Mr. Ma. Pra. Dikshit, the firm Purchase & Sales Exchange got the distinction of exporting to European countries, years ago, when exports were unheard of. Mr. Dikshit was importing and exporting a number of chemical items. Despite a sudden set back recently, the firm managed to limp back & has now entered into bulk chemicals business in caustic soda, sulphuric acid etc.

Mr. Tejkumar Dikshit, the illustrious son of Mr. Ma. Pra. Dikshit, is now at the helm of affairs. The young Dikshit has ventured into newer pastures, developing wider business activities. 'Chemical Weekly' which has had the good fortune of associating with Mr. Dikshit since long, wishes 'Purchase & Sales Exchange' Many 'happy returns'.

SAIL TECH. MAKES A BREAKTHROUGH

Inhouse technology developed by the SAIL's Research and Development Centre of Iron and Steel (RDCIS) has made a breakthrough. SAIL sources said Mecon using SAIL's technology has bagged a Rs. 34 crores contract for the dolomite brick plant under the modernisation programme at the Rourkela Steel Plant (RSP) after competing with others using a foreign know-how.

The RDCIK Technology was found at par after extensive evaluation by the RSP who were among the first few to adopt it, the sources added. The hot pressing technology for dolomite bricks was developed by the RDCIS through elaborate investigations including actual plant trials.

The new products have increased shelf life and physico-chemical properties which have resulted in extending the application of dolomite refractories with improved techno-economics as compared to other lining materials. The sources said the pitch bonding technology was being introduced in all the captive brick making units of the SAIL plants.

The dolomite lining with various improvements was still a common refractory in advanced countries like USSR and Europe, they added. The sources said India has entered the club of those advanced countries who have their own technology of hot pressing dolomite refractories. It has taken a strident step towards indigenisation and self sufficiency in technology. This indigenous technology would save India from repeated investment in foreign know-how avoiding unnecessary taxation on the exchequer.

DEPOSITS OF SILICA SANDS FOUND IN VEDARANYAM IN TAMIL NADU

High quality deposits of silica sands useful for sheet glass industry and foundries have been found by the State Department of Geology and Mining in Kariyapattinam and Thillavilagam in Vedaranyam taluk of Thanjavur district. The silica sands have been sent to the Central Glass and Ceramics Institute, Jadhavpur, for analysis.

Fire, chemical accidents increase in Maharashtra

There has been a marked increase in the number of accidents caused by fires and hazardous chemicals and gases even though the overall number of industrial accidents in Maharashtra has declined by nearly 50 per cent during the last seven years. This is stated in a report prepared by the state chief inspector of factories Mr. S.N. Mirasti and presented at a meeting of the Maharashtra State Labour Advisory Board held at Bombay on October 9.

The report points out that the number of industrial accidents in Maharashtra has declined from 97,000 in 1981 to 48,000 in 1988. The number of factories in Maharashtra had increased from 15,000 in 1980 to 21,000 at present. Many of the new factories were chemicals units which used new chemicals and gases which were explosive and poisonous.

The report states that not only chemical units had increased, but more and more industrial units were using hazardous chemicals and explosive gases. There was therefore an urgent need to give priority to the health and safety of the industrial workers by making suitable amendments in the Factories Act.

The owners of the factories should be made responsible for the accidents entrusted with the responsibility of educating their workers on safety and health measures. The inspectorate of factories has drawn up a list of 117 chemicals and gases, and workers using them should be educated in the hazards they pose to their life and health and the safety measures to be taken in case of an accident.

The report has recommended that companies using hazardous chemicals should obtain approval from the site approval committee and the workers and residents in the vicinity of the units should be informed of the chemicals being used. Such factories/companies should also prepare an at-site emergency drill in case of mishaps to minimise loss of life and property.

The workers of such factories should be medically examined periodically and they should be allowed to see their health reports. The workers should be given the right to get themselves educated on safety measures in recognised institutions and they should be free to collect information about hazards in their factories and allowed to represent on the insecurity and hazards in the factories to the factory management, safety committees and factory inspectors.

Till now the responsibility for the health and safety of the workers was not fixed. But as per the recent amendment the managements of companies have been termed as beneficiaries and the responsibility has been nailed on them. A committee headed by the chief inspector of factories has so far visited 90 out of the 235 factories termed as hazardous and suggested additional safety measures that were required to be taken by them.

The report disclosed that a disaster plan prepared by the inspectorate for Pune has been selected by the Central govt. to be implemented as model plan by other states. The report said that the Central government was currently planning to adopt a major hazard control project in the country. The project was being prepared by an international team of experts who visited India recently and inspected the hazard control methods presently being followed. A total of 75 factories in the state have been classified as major hazard factories. The government was also taking steps to make appointment of safety officer compulsory in factories having more than 1,000 workers. Companies having lesser number of people but using hazardous chemicals or processes would also have to employ safety officers.

DECLINE IN COPPER PRICES FORECAST

Copper prices are likely to see a fall in the next few years, an increase in global production would also see copper's increased use by various industries. This forecast was made by international experts following a global survey which has already been vindicated by a fall in prices in international market as well as in India.

The international experts stated that the fall in copper prices would basically be due to the renewal of labour contract in Mexico, Peru, Canada and USA and major copper producing nations. Production in these countries was curtailed due to labour problems. Another reason for prices shooting up was a production fall in Zambia and apprehension of a fall in Chilean copper output due to crippling power cuts.

The survey points out that the average "high estimate" copper price which was US Cents 118 per pound, would come down to US Cents 116 in 1989 and US Cents 100 in 1990. This has come as a welcome sign for copper producing nations because the metal's price has been on the hike for quite many years. Meanwhile, the average copper price in India has been on an upward trend for last few years. While in 1987 the price per metric tonne was Rs. 50,750, it increased to Rs. 73,750 and Rs. 86,438 respectively in 1988 and 1989. With the increase in global production, this is expected to come down.

IPCL DIVIDEND

As in the four previous years, Indian Petrochemical Corporation Ltd. (IPCL) has repeated a dividend of Rs. 18.6 crores for the year ended March 31, 1989. The dividend cheque was presented to the Union Industry Minister, Mr. J. Vengala Rao, by the IPCL Chairman and Managing Director, Mr. Hasmukh Shah, at Baroda.

Alidac Genetics to market blood products

Alidac Genetics and Pharmaceuticals, an associate of the Cadila group, has entered into a collaboration with Institut Merieux, France, to market the much-needed blood products in India.

Institut Merieux, France, is the world leader in blood products and vaccines. The Alidac Merieux collaboration will introduce Albudac, a human normal serum albumin in a 20% solution. Human albumin is a blood component forming the largest fraction of a serious protein. It is responsible for the maintenance of concotic pressure, blood volume arterial pressure and blood viscosity. It also acts as a transporter and has anti-sludge function.

As a substituting agent, human normal serum albumin is invaluable in pre and post-operative nutritional re-equilibration in hypovolemic, malnourished or infected patients. It is recommended in extracorporeal circulation, dialysis and plasma exchange as well as for transfusion. The collaboration is all the more significant, as the blood products manufactured in India have been withdrawn by the Government early this year. This withdrawal has been due to the doubt about the quality of the blood used and the fact that many samples were found positive for HIV anti-bodies (AIDS).

However, the fractionation technique employed in manufacturing albumin at Institut Merieux, France, guarantees the absence of HIV virus. Each batch of Albudac would be manufactured and tested at Institut Merieux and would again be tested in India for the presence of AIDS virus before it is made in the Indian market.

TWO AMERICANS BAG NOBEL PRIZE FOR MEDICINE

The Nobel Prize for medicine was jointly awarded to two Americans J. Michael Bishop and Harold E. Varmus, on October 9, it was announced at Stockholm. They were awarded the prize for their research into how normal cells become cancerous. They expressed surprise and bewilderment, upon learning they had won the 1989 Nobel Prize.

The researchers began collaborating in 1970 on the theory that the cause of cancer may lie within the human cell itself.

"The prize is based on some work we did for about 10 years showing that one of the retroviruses that causes cancer has a carrier gene derived from a normal cell", Varmus said. "That nurtured the idea that many retroviruses do the same thing, and it gave rise to the idea that all cancers are caused by derelict genes."

Bishop said their study of viruses provided evidence that genetic information that can cause cancer was part of the "genetic gallery" of all humans and all animals.

GODFRY PHILIPS TO SET UP PFY UNIT

Godfrey Philips India Ltd. a leading company of the Gujarmal Modi group, is promoting a Rs. 280-crore project in Madhya Pradesh for the manufacture of polyester filament yarn (PFY). The project which is proposed to come up near Gwalior, is being jointly promoted by the Modi and Madhya Pradesh Audyogic Vikas Nigam (MPVN).

The Modi project assumes significance in the light of the fact that it will introduce an entirely new technology in this field. At present most of the yarn which is manufactured is of two denier thickness. The Modi project, however, proposes to manufacture yarn of only one-and-a-half denier thickness. This will be a major step forward in improving the quality of synthetic fabrics.

No more caustic soda glut

The caustic soda industry has taken off the ground after a long period of glut and competition from cheaper imports. The glut situation has virutally disappeared and the industry is just producing what it can sell. Against a demand of 9.1 lakh tonnes projected in 1989, the estimated production is 9.2 lakh tonnes. Last year caustic soda units produced 8.51 lakh tonnes against an offtake of 8.41 lakh tonnes.

For the first time, the caustic soda industry entered the international market last year by exporting 10,000 tonnes. The export in the first quarter of 1989 accounted for 6000 tonnes. In the past few years the industry had an extremely low capacity utilisation due to slack offtake and unhealthy competition from imports at unrealistically low prices.

This was the major reason which prevented caustic soda units from taking up exports on a large scale. However, since early 1989, global caustic soda prices are ruling firm to the advantage of Indian industry. On the domestic front, a steady rise in demand for the chemical, facilitated mainly by a boom in the detergent industry, has changed the scenario dramatically.

Indigenous offtake of caustic soda rose to 8.41 lakh tonnes in 1988 from 7.75 lakh tonnes in the previous year. The demand is expected to go up to 9.1 lakh tonnes in the current year and may even reach 10 lakh tonnes. The total installed capacity of the industry was placed at 11.66 lakh tonnes in April 1989. An additional capacity of 3.46 lakh tonnes has been sanctioned by the government since then. Since a grassroot caustic soda plant is highly capital intensive, it is unlikely that many new plants will be set up in the near future.

Since the capacities of most of the units are much below international levels. the thrust in capacity addition would be in the direction of expansion, industry sources feel. Some units are already taking steps for expansion and modernisation of their plants. It is anticipated that more than 2 lakh tonnes of capacity would be added by 1991-92.

The sources say that to sustain the export of caustic soda, the government should enhance the cash compensatory support to 12 per cent. Moreover, the CCS should be extended to caustic soda lye and solid forms. A major problem faced by the caustic soda units is the steep rise in raw material costs. For instance, there has been a noticeable drop in the availability of salt since last year, leading to a sharp rise in the prices.

GNFC ABANDONS ACETIC ACID PROJECT

Gujarat Narmada Valley Fertilisers Company Ltd. (GNFC), has abandoned its controversial project to produce 40,000 tonnes of acetic acid from methanol, it is reliably learnt. Industry sources say it is a unique case of a large corporation giving up a project after having converted its letter of intent into an industrial licence.

In addition to loss of face, the corporation will be losing money already spent on the project, according to sources. Meanwhile, the Managing Director, Mr. Ramanathan, is being given another assignment by the Gujarat Government, a GNFC source confirmed.

The company has now submitted another proposal for setting up an export-oriented methanol-based acetic acid project for the same capacity and at the same location. However, 40,000 tonnes is regarded as an uneconomical capacity for such a project and industry sources are sceptical of its success. To compete internationally, such a project should have about 1.5 to 2 lakh tonnes capacity according to BP Chemicals of UK, the process licensors.

Meanwhile, GNFC's formaldehyde project has also kicked up a controversy. Some 16 existing manufacturers of the chemical are now working at around 30 per cent capacity due to inadequate demand. If the existing units are to expand to 30,000 tonnes each, the minimum economic capacity fixed by the Government, the total capacity in the country will increase to 4.8 lakh tonnes, sources said. Most units however are not keen on expansion in the absence of a large enough market to absorb new production.

According to industry sources, GNFC project envisages a foreign exchange outgo of nearly Rs. 6 crores, out of which Rs. 2 crores will be for foreign knowhow, a charge not denied by the company. It may be noted that except in the case of the first few formaldehyde plants in the country, all subsequent plants have been based on indigenous technology without involving any foreign exchange outgo.

NIRMA KEEN ON SODA ASH UNIT IN AP

Nirma Industries has shown keen interest in setting up a soda ash manufacturing unit at Masulipatnam, stated A.P. Chief Minister Mr. N.T. Rama Rao at Hyderabad recently. Stating that the recently announced incentives policy has already evoked a very good response from industry, Mr. Rama Rao stated Nirma are also putting up a LAB project at Visakhapatnam for which they had obtained a letter of intent from the Centre.

APIDC has been holding a letter of intent for soda ash manufacture since long. An outstanding feature of the new incentive policy announced by the State Government is that there is no ceiling on the amount of Sales Tax deferment which could be as much as the total project cost in the three backward districts and upt to 75% in all other districts. According to Mr. Rama Rao the LAB project of Nirma Industries will be eligible to get the Sales Tax incentive.

Tax holiday for soap industry suggested

The steering committee on small scale detergent and soap industry headed by the United Bank of India Chairman, Mr. J.V. Shetty, has suggested three-year tax holiday for the detergent and soap manufacturers in the small scale industry in West Bengal. This has been mooted as an alternative in case the State Government is unable to exempt the SSI units from paying Sales Tax.

The committee report, as disclosed by Mr. V.K. Jain, President of the Small Scale Detergent and Soaps Manufacturers Association, at its annual general meeting at Calcutta on October 3, noted that with three years' sales tax holiday, the production tonnage and the revenue on account of the two per cent sales tax levied on the raw material inputs and two per cent octroi together would be much higher against the revenue earned by the State Government presently on account of eight per cent local sales tax on detergent powders and cakes.

The State's earnings through sales tax on finished goods is only around Rs. 20 lakhs per annum on a total production of 7000 tonnes of detergents per annum from SSI units. With three years' sales tax holiday revenue is expected to be increased to Rs. 4.12 crores per annum.

Within 1990-91 detergent production in the SSI units is estimated at 40,000 tonne per annum whereby the revenue earnings on raw materials as well as the octroi duty would amount to Rs. 62.12 lakhs in 1989-90.

The report further recommended that the detergent products of the small scale detergent industry in the State should be marketed through the public distribution system. This would enable the common man both in the urban and rural areas to get a quality product at a reasonable price.

Mr. Jain said the implementation of the recommendations of the committee would ensure a sharp upward swing in detergent production, employment generation and revenue earnings.

NALCO EARNINGS

The public sector National Aluminium Company (NALCO) has closed the first half of 1989-90 with an impressive foreign exchange earning of over Rs. 152 crores. This represents an increase of more than Rs. 97 crores over the same period of 1988-89, says a National Aluminium Company release. During the period, the company exported over 2,08,000 tonnes of alumina and 9,450 tonnes of high grade aluminium to various countries.

HIGH TECHNOLOGY PLANT FOR EFFLUENT TREATMENT

Hindustan Dorr-Oliver Limited has been awarded by Indian Yeast Company, Uran, Maharashtra, a subsidiary of Shaw Wallace, a turnkey contract for an effluent treatment plant involving high technology. Indian Yeast is the biggest producer of yeast in the country. During processing, the plant generates three effluent streams and two sludge streams requiring exhaustive treatment prior to disposal.

Hindustan Dorr-Oliver came forward with the solution by offering a unique technology which, while degrading the waste matter, produces biogas — a potential source of energy. The process wastewaters from the yeast unit are comparatively concentrated streams. These are combined and after pH correction pumped to an anaerobic fluidised bed bioreactor.

It has now become possible to convert the waste organics into potential energy as biogas. The biogas generated consists mainly of methane (65-70 per cent) and the balance carbon dioxide with traces of hydrogen sulphide. Biogas is collected in a floating roof dome of the sludge digester and taken to a steam boiler to be used as supplementary fuel. The scheme of treatment was developed by HDO after a detailed treatability study.

A. SARAOGI: NEW ICMA PRESIDENT

At the Fortyninth AGM of ICMA held in Bombay on Sep. 27, Mr. Atmaram Saraogi, Managing Director, STP Limited, Calcutta, was elected President of the Association for 1989-90. Dr. K. Narayanan, Chemplast, was elected Vice President.

The following were elected as Regional Chairmen for the year: Mr. D.M. Kothari, Goodlass Nerolac Paints Ltd., Western Region, Mr. K. Ramamurthy, Mettur Chemical & Industrial Corporation Ltd., Southern Region, Mr. O.P. Malhotra, Phillips Carbon Black Ltd., Eastern Region & Mr. S.N. Tandan, Ballarpur Industries Ltd., Northern Region.

INDO RAMA COMMISSIONS PLANT

Indo Rama Synthetics (India) has successfully commissioned its plant ahead of schedule. According to a company release issued at New Delhi recently, its spinning unit at Pithampur near Indore in Madhya Pradesh has started the commercial operation from July to September. The company has already sold yarn worth Rs. 3.5 crores. Out of this Rs. 2.25 crores worth of yarn went for the overseas markets.

The company is exporting its yarn to Belgium, United Kingdom and Switzerland. In view of its higher demand from the overseas as well as domestic buyers the company has decided to instal an additional 4,224 spindles at an estimated cost of Rs. 5 crores. This expansion is expected to be completed by Feb. 1990. The company has decided to finance this expansion programme from its internal accruals and loans.

Panel likely to study direct tax law changes

The Government proposes to set up an expert committee to study rationalisation of direct tax laws, the Finance Minister, Mr. S.B. Chavan, told the Lok Sabha. Replying to the debate on the Direct Tax Laws (Second Amendment) Bill, he said rationalisation of taxes would help the tax payers avoid consulting too many experts.

Mr. Chavan said the income tax forms would be simplified with queries only on essential information. Experts were being consulted for this purpose, he said. He said the forms were bulky because these were in Hindi and English. The Official Languages Department has been insisting that the forms should be in English and Hindi.

Mr. Chavan said there was no need for the honest people to be afraid of the Income Tax Department. Now 97 per cent of the self-assessment filed by returnees were accepted by the Department, he said. Earlier, moving the Bill for consideration, Mr. Chavan said, the 'prime urgency' for bringing the Bill was to help tax payers who were experiencing certain difficulties as a result of the new assessment procedure in force since April this year and also to grant certain tax concessions that can be availed of during the current financial year.

He said it was proposed that the computation of capital gains in the case of NRIs will be made by calculating the cost price and sale price in the foreign currency in which the investment was made instead of taking the value of the Indian currency. The Bill also seeks to extend the period of stay in India for NRIs to look after their investments from 90 days to 150 days in a year without losing their non-resident status. It also provides for certain concessions to the capital intensive shipping industry facing stiff competition from foreign shipping lines.

A new section in the Act has been proposed so that in computing income from the business of shipping company a deduction will be allowed of an amount credited to the reserve account, limited to the profit of the relevant year.

The reserve so created will be utilised for purchase of a new ship within eight years. There is a concession also for non-resident sportsmen and sports associations whose income in India would be taxed at a concessional rate of 10 per cent. Mr. Chavan said it was also proposed to amend section "80-C" of the Income Tax Act to extend tax concessions under it to "such unit-linked insurance plans of the LIC mutual fund as may be notified by the Central Government — and such saving certificates issued under the Saving Certificates Act, 1959 as notified by the Government".

Certain amendments proposed are of clarificatory nature. The major changes are: The date for filing the returns by the partners in cases where the firms' accounts are required to be audited has been made the same as in the case of the firm, that is, October 31 of the assessment year.

UNDERINVOICING OF HDPE ALLEGED

Plastic processors have alleged large-scale underinvoicing of polyethylene imports through the Calcutta Port by local traders says a 'Financial Express' Bureau despatch. The racket has been going on for quite some time despite representations by the industry to Calcutta Port and the Union Government officials. The racketeers are becoming more audacious and their operations are becoming more widespread, processors complained.

The material in question is high density polyethylene, especially Marlex brand of Phillips Petroleum of Singapore. It is shipped to Calcutta traders not by Phillips, but by Indian-owned outfits in Singapore. The international price of HDPE is around \$800 a tonne, depending on the grade. The same brand imported through ports other than Calcutta bear this price tag.

However, the same brand and quality material prices at \$650 a tonne passes through Calcutta Port without any hassles. "Financial Express' has seen a Singapore invoice quoting Singapore \$1258 (US dollar 600) a tonne. More recent invoices bear \$570 price. It is clear that Phillips material is purchased by local traders in Singapore at the company's fixed price and sold to the Indian counterpart at \$600, the balance transferred through illegal "havala" channels. Indigenous HDPE costs about Rs. 32 a kg. At \$800 a tonne, imported material costs Rs. 13,600 plus Rs. 15,640 (Import duty at 114.5 per cent) plus Rs. 300 clearing charges, totalling Rs. 29,540 (approximately Rs. 30 a kg.).

Underinvoiced imports at \$600, after adding Rs. 11,730 customs duty, Rs. 300 clearing charges and the havala charge of Rs. 2,600 (Rupee equivalent of \$130, the havala rate being Rs. 20 a \$) add up to Rs. 24,830. This material is thus cheaper than genuine imports by Rs. 4 to Rs. 5 a kg. Industry sources say that as much as 2,000 tonnes of underinvoiced material are cleared by Calcutta Customs every month, flooding the East and North Indian market.

ADARSH CHEMICALS

Mr. D.J. Patel, chairman of Adarsh Chemicals and Fertilisers Ltd. has expressed the hope that the company would be able to market about 80,000 tpa of single superphosphate and retain its major share in the indigenous market for maleic anhydride even after new units are commissioned. Addressing the annual general meeting of the company, Mr. Patel added that the rights equity issue of the company will open for subscription on November 15, 1989.

N-POWER TECHNOLOGY

India's advancement lauded

India ranks among the developed countries in nuclear power technology advancement, Dr. R. Schelenz of the International Atomic Energy Agency (IAEA) said recently. Talking to newsmen at the Indira Gandhi Centre for Atomic Research (IGCAR) at Kalpakkam, Dr. Schelenz, who leads the chemistry division of the IAEA said India played a vital role in assisting IAEA in transferring technology to other countries.

Dr. Schelenz was hesitant to comment on nuclear power development in India saying it would not be proper to assess a member country. He said after the Chernobyl nuclear plant accident there was an increasing awareness among the people about safety aspects and the IAEA was assisting the member countries in setting up national monitoring centres. More than 40 countries especially in West Asia and Africa have benefited so far. These countries depend heavily on food imports from Europe.

Earlier addressing a regional cooperation agreement workshop of Asia Pacific countries on "environmental sampling and measurements of radioactivity for monitoring purposes", Dr. Schelenz said the IAEA had strengthened its activities in the field of radionuclide monitoring in food and environmental samples under the supplementary programme on nuclear safety soon after the Chernobyl accident.

The agency felt that guidance for member states was needed to deal with large number of samples to use appropriate measuring equipment and provide analytical capabilities of their own to produce reliable results, he said. Dr. Schelenz said the purpose of these activities was to ensure that the member states improved their capabilities and prepared themselves for any accidental releases of radioactivity including those involving transboundary effects.

He said the spectrum of training should be broad in view of the diverse nature of accidents such as the release of strontium-90 in the Urals accident, caesium isotopes in Chernobyl and the release of tritium and iodine in the Three-Mile Island accident in the U.S.

In his inaugural address, the IGCAR Director, Mr. C.V. Sundaram, said the country has gained expertise in all aspects of nuclear energy right from prospecting fuel, reprocessing of fuel, building reactors and waste management.

He said in India environmental concern had found a rightful place since the inception of the nuclear power programme. This had been exemplified by the fact that the first of the environmental surveillance laboratories was set up in 1958 at the Bhabha Atomic Research Centre (BARC) at Trombay.

He said all the atomic power sites in the country had active monitoring centres that were manned by trained scientific personnel and possessed modern equipment. They not only monitored the environment but also demonstrated the negligible impact of the nuclear power stations on the environment.

The week-long workshop organised by the BARC in collaboration with IAEA is being attended by experts from Indonesia, Thailand, Korea, Malaysia, China, Singapore, Vietnam and Japan besides India.

Radon emission high in west

The radon emission is creating serious problems in the western world, Dr. Schelenz said. Exposure to radon, a radioactive noble gas like argon and krypton is much higher than the radiation from the nuclear power plants.

The problem is not so severe in countries like India in the tropical belt in view of sufficient ventilation in dwelling places. Dr. Schelenz said the exposure limits in the western countries of radon, the first disintegration product of radium, is as much as 32 per cent.

The radioactive gas is generally released from the walls of concrete buildings by decayed atoms. Most of the buildings in the west are closed and without proper ventilation. The other reason for such high exposure is the granite belt across the Scandinavian countries, Finland and Canada. The belt is a special source of concentration for uranium. The problem became more acute since the energy crisis, he added.

According to a monograph of the Indian Society for Radiation Physics, natural radiation contributed about four-fifths of the average annual radiation dose worldwide. The sources of natural radiation are extra-terrestrial and terrestrial in origin and together they cause external and internal exposures.

The estimated annual exposures of man to natural resources of radiation in areas of normal background is put at 200 milliroentgen per year (MR/Yr) with cosmic rays alone accounting for 30 MR year. Primordial nuclides in soils and rocks contribute a little over 165 MR/year. Uranium-238 series alone inflict an internal exposure of 95 MR/year.

However, in areas of high background, the exposure levels vary over an order of magnitude depending upon the site specific terrestrial radioactivity. For instance, in Kerala with a rich monasite sands the natural exposure is as high as 1600 MR/year. Elsewhere, the levels recorded are 1800 MR/yr in Black Forest in Germany, 2200 MR/yr in central city of Colorado in the US and 17,000 MR/year in Guarapari in Brazil.

According to an IAEA document, in the UK nearly 87% of the total radiation exposure came from natural resources, with the balance 13% coming from artificial sources. Even among the artificial or manmade sources, bulk of the exposure are accounted for by medical sources, both in diagnosis and therapy. Exposure due to nuclear discharges is only a fractional 0.1 per cent, it said.

Imports of ammonia canalised

The Commerce Ministry has decided o canalise imports of phosphoric acid nd ammonia through the State Trading Corporation (STC) with immediate ffect. A notification to this effect was ssued on 6th October. So far phosphoric acid and ammonia were being mported through the Department of Fertilisers, which was entrusted with the ob several years back through a special circular.

However, lately the Finance Ministry has been pressing upon the Government to transfer the canalisation of the wo raw materials through the Commerce Ministry so that all fertiliser mports are handled by one administrative department. The STC chairman, Mr. Bhupinder Singh, had also recently made a representation to the Commerce Ministry expressing its keenness to handle phosphoric acid and ammonia mports.

Mr. Singh had pleaded that the turnover of the Corporation was going down due to steep fall in edible oil imports, hence canalising the phosphoric acid and ammonia imports through it would help build the turnover and maintain the overheads of the corporation at reasonable levels. The commerce Ministry, after detailed evaluation, decided that a balance be created between the two premier trading organisations of the country — STC and the Minerals and Metals Trading Corporation (MMTC) — in regard to turnover.

MMTC, which was the other choice for the Commerce Ministry, today has turnover of around Rs. 5,000 crores while STC's turnover is expected to be just Rs. 1,500 crores during the current year. A similar exercise was undertaken by the Govt. about two decades back when the fertiliser imports were handed over to MMTC to bail the corporation out of a falling turnover crisis. At that time STC was handling fertiliser imports. The latest Government decision to canalise imports of phosphoric acid and ammonia through STC would help the Corporation increase its turnover to around Rs. 2,000 crores. India imports about one million tonnes each of phosphoric acid and ammonia. The largest supplier of the two essential raw materials is Morocco, followed by the US and Senegal.

STC had also argued that while there was a vast difference in the turnovers of the two Corporations, the number of employees and amount of overheads were more or less the same. Both Corporations have more than 2,500 employees and their overheads are around Rs. 30 crores. Following the liberalisation policy initiated by the Government, the number of canalised items from STC have been declining sharply. In 1974-75, STC was handling about 120 canalised items when it had 1,800 employees, which came down to just 49 by 1979-80 (2,200 employees), to 38 by 1984-85 (2,450 employees) and finally to 11 in 1988-89 (2,600 employees).

STC has hence pursued an aggressive export policy on the non-canalised front and has targeted for exports of Rs. 560 crores in this area. Already it has made shipments worth Rs. 261 crores of non-canalised items during the April-August period. With phosphoric acid and ammonia coming its way, STC could well use its buying strength to increase counter trade by ensuring additionality in exports.

OSWAL GROUP TO SET UP DAP UNIT

In a bid to further consolidate its presence in fertiliser sector, the Oswal Group proposes to set up a 3.5 lakh tonnes capacity DAP plant. The plant, to cost about Rs. 200 crores, would be set up in Uttar Pradesh near the prestigious Shahjahanpur fertiliser project. The plant is proposed to be set up by Bindal Agro, one of Oswal group of industries, which is also at present in the process of erecting the gas-based Shahjahanpur project. According to company sources an application for the project would soon be submitted. The project would be partly financed by the public issue and mainly from the internal accruals. The detailed feasibility report is being worked out.

With good liquidity base and proven technology, the Oswal group's Chairman, Mr. Abhey Oswal, has claimed that the Rs. 700-crore fertiliser plant would be completed in 24 months. Bindal Agro also plans to double the capacity of the plant after the first year of production estimated at 15 lakh tonnes. This would entail a cost of about Rs. 400 crores.

The sources point out about 20 per cent of the expansion cost would be met by the profits generated from the project and the balance would be raised from the public. Another company of the group, Oswal Agro mills, is also expanding fast, it has drawn up plans to invest another Rs. 1,000 crores in various projects like doubling of petrochemical capacity, doubling of LDPE capacity and takeovers of couple of fertiliser-based companies.

SIX TIE-UPS APPROVED FOR PENICILLIN-G

Six foreign collaborations for manufacturing penicillin-G were approved in July. Four of these were with Italian firms, one each with Czechoslovakia and Portugal. Five of these were for transfer of technology and one financial. A collaboration for getting drawings and designs for manufacturing safety razer blades and twin blades shaving systems with a UK firm was also approved during the month.

The financial collaboration with a Bahrain based Indian and a US firm to manufacture decorative stained glass was approved. Nine of these were with Italy, six each with the US, the UK and West Germany, five with Japan, two each with Switzerland and the Soviet Union and one each with Czechoslovakia, France, the Netherlands, Poland, Portugal and the other with a non-resident Indian.

DGTD to set up know how centre

The Directorate General of Technical Development (DGTD) is in the process of establishing a technology information centre (TIC) to meet the information needs of user industries in select sectors.

This was announced by the secretary (TD) and DGTD, Mr. H.C. Gandhi, at a workshop on technology information services, organised by DGTD, the delegation of the commission of the European Communities and the Confederation of Engineering Industry (CEI) at New Delhi.

Mr. Gandhi indicated that DGTD with the support of the delegation of the commission of the European Communities and in consultation with prospective users — industrial units and associations, development finance institutions and RD organisations — was setting up the centre initially to provide information on future development trends and sources of supply of commercially proven technologies.

Mr. Gandhi observed that this was the first centre of its kind to be established in the country and technical assistance of the delegation of the commission of the European Communities was, therefore, being sought.

The head of the delegation of the commission of the European Communities in India, Mr. Robert Houliston, mentioned that the technology data-base development programme with DGTD was an important part of the co-operation between EEC and India.

EEC expertise was being made available to India in setting up the centre. Every effort was being made to ensure that the information collected, collated and analysed would be relevant to the Indian context.

Such information would also be state of art and facilitate Indian Industry's efforts to become more efficient and productive. The chairman and managing director of CMC, Dr. P.F. Gupta, referred to the capabilities within the country for setting up network information systems.

He emphasised that Indian organisations and personnel had successfully developed a number of information networks to cater to a wide spectrum of services.

Dr. Gupta felt that in developing any data-base, constant updating was essential. In his view, no data base would be meaningful unless it was current. To achieve this, an efficient mechanism needed to be instituted.

The CEI vice-president, Mr. V. Srinivasan, referred to the management challenges involved in setting up a strong technology information system in the country.

First and foremost, there was a need to change attitudes and encourage people, organisations and businesses to share information.

MORE BRITISH HIGH-TECH PRODUCTS FOR INDIA

Spantech Products Ltd. of South Godstone, Surrey, England have received a prestigious order for gas analysis instrumentation based on the Servomex 700B Zirconia Oxygen analysers. The customer is the Linear Alkyl Benzene plant of the Indian Petrochemical Corporation Limited, (IPCL) in Baroda.

Spantech Products Ltd. are the exclusive representatives of Servomex Plc of Crowborough, Sussex, for India. This order is one of several received by Spantech from IPCL including the nitrogen gas generator type Nitrox NG 300 for their quality control laboratory.

Spantech Products Ltd. have established sales and service centres with UK trained engineers in Calcutta, Delhi and Baroda. Local service contracts, both on casual and annual basis, have been provided for customers' gas analysis instruments.

Customers include the Nuclear Power Corporation, Industrial Oxygen Ltd., the Steel Authority of India and many companies in the Baroda area. More centres are planned for hi-tech products in the Indian network located in Bombay, Madras, Patna and Cuttack.

BRITISH FIRM TO PROMOTE HOT MELT ADHESIVES IN INDIA

A hot-melt polyamide resin adhesive that is fast, non-toxic, non-hazardous and non-flammable will be promoted during the trade mission to India organised by the Birmingham Chamber of Commerce from 3 to 10 October.

Mr. Rodger Spooncer, Sales Manager of Evacor Resins, will be talking mainly to shoe manufacturers, though his company's resins are used also in thermographic printing, the production of cans, batteries and oil filters, and many other areas of manufacturing.

Polyamides offer many health and safety benefits in manufacturing. They also bond in seconds, compared with the 15-20 minutes taken by some adhesives; output is increased and quality improved.

Evacor currently supplies resins to the Bata group, which has shoe factories in Lahore and Calcutta. As well as visiting that organisation, Mr. Spooncer will investigate the possibility of establishing distribution to reach new customers.

The company which is part of the Evode group exports 70 per cent of its output.

For further information please contact: Evacor Resins Limited, Common Road, Stafford, England ST16 3EH. Telex: 36161, Fax +44 785 55093.

National debate sought on small units woes

Mr. R.M. Dujodwala, President of All India Manufacturers' Organisation (AIMO), has said in a press release that the Government should invite the heads of apex bodies from all over the country to present their views on problems facing the small manufacturers.

The Government can then make necessary changes in the status of small manufacturers which would satisfy an overwhelming majority of them, adds the release.

The investment of 95 per cent of SSI units range between Rs. 2 lakhs and Rs. 10 lakhs. In spite of this, there is a demand from certain quarters to raise the investment limit beyond Rs. 35 lakhs. There are also conflicting views on the clubbing of investment, if such units are owned by common partners or proprietor or directors.

One view is that, even if a large unit has separate installations at more than one place, limiting the investment of each to less than Rs. 35 lakhs, it cannot fall under the category of small-scale sector, if the total investment exceeds Rs. 35 lakhs. But some others feel that when each unit is properly registered and is working separately, it should be considered a small-scale unit and should be entitled to all statutory benefits, irrespective of its ownership.

There is also another opinion that small-scale units should not be given licence for permanently enjoying the benefits as a small unit. This status should be limited to a particular period, say 10-15 years, and small-scale manufacturers should be encouraged to grow into a medium-scale and thereafter to a large-scale unit. This will help new small-scale units to take the place of old units and have a multiple effect on the industrialisation of the country.

Small-scale industry is the back-bone of the country's economy and 40 per cent of its production is exported. It also provides employment to a large number of people. This sector has its own significance and, therefore, the cloudy atmosphere should be cleared as early as possible, adds the AIMO president.

PHILLIPS PETRO LAUNCHES PPS RESIN

Phillips Petroleum of United States has launched polyphenylene sulphide (PPS), a new engineering plastic resin, in the Indian market. PPS has high temperature resistance and excellent dimensional stability which makes it a choice material for several engineering and electronic applications. PPS (a Phillips Petroleum discovery and monopoly) is gradually being used by Larsen & Toubro and Crompton Greaves in their switchgears. Its electronic applications include connectors, transistors, copier and VCR components and PCBs.

Its remarkable dimensional stability (it won't expand or contract in high or low temperatures) has made two watch manufacturers — Hindustan Machine Tools and Allwyn — patronise it. Titan is experimenting with the polymer. Indian Telephone Industries (ITI) is about to use PPS in the manufacturing of telecom connectors.

Japan, the world leader in electronics, is using PPS in a big way. Phillips Petroleum has recently commissioned a plant in Japan and has begun marketing the material in Asia. In United States, PPS is used in large quantities in the making of missiles, spacecraft and the like. The Indian Defence Research and Development Organisation (DRDO) is reportedly experimenting with the polymer. As PPS does not find a mention in the Import-Export Policy, it attracts the maximum import duty of 240% ad valorem. This makes the landed cost as high as Rs. 500 a kg. Like other speciality polymers, it can be imported at a concessional rate of 35 per cent duty for use in electronic goods.

Rs. 280 cr. Modi PFY project in MP

Godfrey Philips India Ltd., a leading company of the Gujarmal Modi Group is promoting Rs. 280 crore project in Madhya Pradesh for the manufacture of polyester filament yarn (PFY). The project which is proposed to come up near Gwalior is being jointly promoted by the Modis and the Madhya Pradesh Audyogic Vikas Nigam (MPVN).

The Modi project for polyester filament yarns assumes greater significance in light of the fact that it will introduce an entirely new technology in this field. At present most of the yarn which is manufactured is of two denier thickness. The Modi project, however, proposes to manufacture yarn of only one half denier thickness. This will be a major step forward in improving the quality of synthetic fabrics.

Godfrey Philips will contribute towards 10 per cent of the cost as promoter's quota while another 10 per cent will come from Madhya Pradesh Audyogic Vikas Nigam. This means each monomer will contribute around Rs. 28 crores in the project.

For Godfrey Philips, the proposed plant forms an important part of its diversification plans. GPI has so far been known primarily as a cigarette company. However, now the company is trying to expand the area of its operations. It has recently diversified into tea vending through its popularly known 'tea city' chain of tea parlours. Besides, the company is also looking into area of electronics for possible investment.

However, the proposal for polyester filament yarn remains its largest foray into fields outside cigarette manufacturing. The proposed PFY plant would manufacture some entirely new user-oriented forms of yarn besides the finer variety. Almost 60 to 65 per cent of the production of the new venture would be of the varieties that have not been introduced in the country as yet.

There are many technological and application innovations that the products of the new company will introduce in the market. The plans for the products include facilities for manufacturing 'easily dyeable polyesters'. Till now the processing houses could not dye polyester yarns as these did not contain suitable additives to facilitate dyeing. The new venture, however, hopes to rectify the anomaly. It proposes to manufacture yarns with special additives for dyeing. Such fibres are likely to find a very large market in inter-weaving of silk, specially because of their properties.

Another interesting variety that is planned for production is 'micro crater' yarn. In these fibres small craters are made on the surface of the fibre. These craters help in producing depth of colour in the yarn. Synthetic yarns at present suffer from inadequacy of richness in colour, which is otherwise shown by natural fibres like cotton, silk and rayon. The new micro crater yarns are expected to make up for the deficiency. The company also plans to introduce 'spun dyes' yarns and flame retardant yarns. The former would save the cost of dyeing at the process houses and prevent pollution which is caused in the process. The flame retardant variety would obviously find welcome use in hotels and household sectors.

NFL BHATINDA UNIT — A DECADE OF SUCCESS

The public sector National Fertilisers Ltd.'s fuel oil based plant at Bhatinda has, during the last 10 years of its commercial production, made a significant contribution to the sustenance of the green revolution in Punjab, an NFL spokesman said. Before NFL set up this plant, Bhatinda and its surroundings were among the most backward areas in the state. The Bhatinda plant has an installed capacity to produce 900 tonnes per day (TPD) of ammonia and 1550 TPD urea. Commencing commercial output on Sep. 1, 1979, it has produced and distributed 15.5 million tonnes of nitrogenous fertilisers in the areas around Bhatinda.

Solar hydrogen — new renewable option

A new energy crisis is rapidly unfolding that may make the oil price shocks of the 1970s seem like minor tremors to the energy system.

The emerging crisis arises not from questions of energy supply, but also from the complex web of environmental problems stemming from the use of fossil fuels. Foremost among the proposed remedies to reduce pollution and ease foreign oil dependence are actions to cut the use of fossil fuels.

Many alternative energy sources have been proposed that address these environmental problems in whole or in part, including methanol as a substitute for oil in transport and nuclear and solar power in place of coal.

But recent technological advances may soon bring one low polluting, renewable option solar-generated hydrogen gas within reach scientists say.

A new technical report released by the World Resources Institute (WRI) concludes that clean-burning solar hydrogen (hydrogen gas produced from water using electricity generated by the sun) is an environmentally safe alternative fuel.

Recent breakthroughs in solar technology mean that solar hydrogen can begin to replace automotive fuels within the next ten years at competitive prices.

The report — Solar hydrogen: Moving beyond fossil fuels states that solar hydrogen is one of the few long-term energy options that can meet the world's energy needs without contributing to the Greenhouse Effect.

Hydrogen can be produced domestically from abundant renewable resources and is as safe to use as gasoline and natural gas.

"We are seeing a new energy crisis unfolding", says the WRI President, Mr. James Gustave Speth. "Fossil fuel combustion is responsible for a complex web of environmental problems".

The report recommends that environmental and other social costs be built into energy prices to guide the development of non-polluting alternative fuels.

Fossil fuel and nuclear subsidies should be eliminated to create a level playing field so that solar hydrogen and other alternative fuels can compete in the marketplace.

Until recently, hydrogen has been considered too costly to qualify as an alternative energy source for widespread automotive and other uses.

Today, however, sophisticated advancements in solar technology are rapidly reducing production costs for electrical energy. In addition, conversion into hydrogen provides an efficient and effective means of storage.

GFL ENTRY LIVENS COOLANTS MARKET

The chlorofluorocarbons plant of Gujarat Fluorochemicals Ltd. went on stream recently, opening up the frigid world of refreigerants to brisk competition.

As the company (promoted by Industrial Oxygen Co. Ltd. and the Gujarat Industrial Investment Corporation Ltd.) began despatches of gas cylinders all over the country. Some established producers are offering reduced prices.

Other producers of chlorofluorocarbons (CFCs) include Aegis Chemicals (which took over Everest Refrigerants, the first Indian plant set up in 1967) and Navin Fluorine, which began operations a year later. Two recent entrants are Mettur Chemicals and Shriram. The demand for CFCs is estimated to be between 7,000 and 8,000 tonnes a year and the demand is growing in tandem with the growth in the refrigeration and airconditioning industry.

CFCs are also used as blowing agents for polyurethane plastics. With the commissioning of GFL the industry's installed capacity is 15,000 tonnes.

Will this not lead to overproduction or underutilisation of capactity? Yes and no, say industry sources. The industry has limited access to acid grade fluorspar, a raw material imported by the Minerals and Metals Trading Corporation as indigenous production meets only a quarter of the requirement. It is unlikely that MMTC will import in excess of the country's requirement for end products.

At the same time, major producers are keen on exports. There is no manufacturing plant in West Asia, a large market

Indian producers have received requests for agencies in this part of the world and are awaiting fixation of input-output norms by the Government.

One danger is that Western countries might arm-twist India and other Asian nations into signing the discriminatory Montreal Protocol on CFCs.

It allows countries like India to produce CFCs without any restriction for ten years, "to meet the basic domestic needs" indirectly for bidding exports.

At the same time, it freezes consumption in Europe and US to 1986 levels. Consumption has been defined as production plus imports minus exports.

At the same time, the protocol allows ten percent increase in production in signatory countries in the West.

With advance information that 1986 will be the base year, most European manufacturers had stepped up their capacities in the preceding two years.

DIVERSIFICATION INTO PESTICIDES

MRTPC urged to restrain big fertiliser co.s

The Pesticides Formulators Association of India, the apex body of small-scale formulators, has moved the Monopolies and Restrictive Trade Practices Commission to restrain large fertiliser companies from diversifying into pesticides marketing.

The Association has raised its objection to the application under Section 22 filed by Zuari Agrochemicals. Referring to reports that Godavari Fertilisers and Chemicals Ltd. plan to market pesticides manufactured by multinationals like Hoechst India, the Association has written to the Government on the implications of the trend which is becoming widespread.

Such diversification will not only affect the business of the small sector, but lead to monopoly situation to the detriment of the farmer, the Association has written in a letter to Mr. M.S. Gill, Secretary, Department of Chemicals and Petrochemicals, Ministry of Industry. It said most of the fertilisers like urea, diammonium phosphate and potash are in short supply and fertiliser units are adept in marketing a product mix of price controlled nutrients in short supply and pesticides which are outside price control. Giant fertiliser units, with their marketing clout and distribution network, can sell pesticides at high prices to subsidise their fertilisers which are under price control. Indeed, such a trend is already evident, according to industry observers.

The following fertiliser units are already in the pesticides business or propose to undertake the same: Zuari Agrochemicals, Godavari Fertilisers and Chemicals, Coromandel Fertilisers, FACT, Ganges Fertilisers and Chemicals, Gujarat Narmada Valley Fertilisers, Gujarat State Fertilisers Company, Hindustan Fertiliser Corporation, IFFCO, KRIBHCO, Madras Fertilisers, Mangalore Chemicals and Fertilisers, Nagarjuna Fertilisers, Punjab National Fertilisers and Chemicals, National Fertilisers, Ramganga Fertilisers, RCF, Shriram Fertilisers and Chemicals, Tuticorin Alkali Chemicals, Udaipur Phosphates and a few more.

The Association had meanwhile protested to the Director of Agriculture, Maharashtra against "unlawful prosecution" of formulators by pesticide inspectors. These inspectors have been prosecuting various firms for failure of their samples in the State laboratory. Under Section 24(4) of the Central Insecticides Act, a producer is allowed to move the court for securing permission to get the sample tested in a free laboratory nominated by the Central Insecticides Board under Central Insecticides Act. In many cases, samples referred to such laboratories have been passed. Despite this, the insecticide inspectors are continuing their prosecution proceedings, the Association alleged.

Producers have also complained of inordinate delays on the part of officials in allowing inclusion of new items in the manufacturing licence. After receiving the CIB registration, manufacturers approach the local licensing authority to get the new products included in their licence. Similarly, there are cases of formulators and technical manufacturers having submitted their manufacturing licence two months in advance of the date of expiry for renewal. Because these are not renewed in time, they become invalid. If the principal licence becomes invalid, the dealer or distributor also lose their permits to stock or sell the goods, thereby disrupting the entire business, it was pointed out.

BRITISH ECONOMICAL AIR FILTRATION SYSTEM FOR INDIA

A British air filter system firm will seek local representatives during a trade mission to India with the Birmingham Chamber of Commerce from 3 to 10 October.

Mr. Sudhamay Bhoumik, proprietor of Bhoumiks, will be aiming at the electro/mechanical and electronics industries.

Bhoumiks offers a simple, economical air filtration system, suitable for use in any industry where clean air is required. The compact system 2000 consists of a range of filters using non-woven synthetic materials in rigid lightweight aluminium framing. The leak-proof mounting system is extremely adaptable and is enhanced by optional filter securing devices and standard filter housing panels.

For further information contact: Bhoumiks, Kensington House, Suffolk Street, Queensway, Birmingham, England B1 1LN. Telex: 336190. Fax: +44 21 643 5514.

PERSONALITIES

Mr. Ramesh Hariani has been elected chairman of Process Plant and Machinery Association of India.

Dr. M.C. Chhabria and **Mr. A.K.A. Rathi** have been elected chairman and vice-chairman respectively of the Indian Institute of Chemical Engineers.

Mr. Sudhir K. Thackersey and **Mr. R.P. Poddar** have been elected chairman and deputy chairman respectively of the The Bombay Textile Research Association.

Mr. R.K. Raman, managing director of Madras Industrial Linings Ltd., Madras has been re-elected president of All India Rubber Industries Association for the year 1989-90.

Mr. Pranlal Bhogilal has been elected president of the All India Starch Manufacturers' Association Private Limited for the year 1989-90.

ENIAL OF SUBSIDY ON EXCESS PRODUCTION:

Fertiliser units likely to be hit?

The proposal to deny subsidy on xcess production to the fertiliser units perating above 100% capacity will ake economists rewrite their books —efficiency will become inversely proortional to returns. In fact, if the proosal is implemented, some of the ighly efficient fertiliser units produc-ng above 100% capacity, will turn red, thers will just fall short of falling sick.

The two units of the Indian Farmers' Fertilisers Co-operative (IFFCO) at Phulpur and Kalol, which had a capacty utilisation of 119.1 and 102.8% in 1988-89, earned a 1.3% pre-tax return on net worth. Had the proposal been mplemented, the reduction in the preax return on net worth because of the lenial of subsidy on excess production would have been 2.6%. This means that he net pre-tax return on the net worth would have been (-) 1.3%.

It would have been a similar story with the Gujarat State Fertiliser Company (GSFC) which has a unit in Baroda producing urea, ammonium sulphate and di-ammonium phosphate (DAP) and another unit in Sikka producing only DAP. In 1988-89 the urea plant of the Baroda unit operated at 106.4%, ammonium sulphate plant at 119.5% and DAP plant at 168.7%. The Sikka unit operated at 102.7% capacity. GSFC's pre-tax return on net worth came to 11.2%. Had the proposal been implemented, the reduction in the pretax return on net worth would have been 14.7%. Therefore, the net pre-tax return on net worth would have come to (-) 3.5%.

The implementation of the proposal could have meant disaster for the Krishak Bharati Co-operative's (Kribhco) Hazira unit which operated at 114.4% of its capacity during 1988-89 and earned a pre-tax return of 1.8% on net worth during the year. The proposal would have reduced the pre-tax return on net worth by 4.2% taking the net return to (-) 2.4%. In the case of the other companies like Rashtriya Chemicals and Fertilisers (capacity utilisation 110%) and Spic (capacity utilisation 113.7%) it would have been a case of touch-and-go with the former registering a nine per cent pre-tax return on net worth and the latter 1.1 per cent.

The Government's desire to cut the subsidy bill is apparently stemming from the possibility of the budget deficit ballooning beyond its control. Industry sources point out that this desire has had the better of the Government's policy of increasing production and productivity, and the basic objectives of the retention price scheme (RPS) have been lost sight of. When introduced in 1977, the intentions, behind RSP were simple: providing fertilisers at reasonable prices to the farmers so that foodgrain production could be increased while keeping food prices under check and giving enough incentives to the industry so that the country becomes self-sufficient in fertiliser.

The twin objectives were sought to be achieved by two strategies — pegging fertiliser prices at a level which makes it attractive for the farmer and then computing the reasonable price a fertiliser company should get.

The difference between the price paid by the farmer and the reasonable return the industry should get is given by the Government. The mechanism by which the Government calculates the returns the industry should get is the RSP.

There has been a substantial deviation from the earlier approach to RSP. Over the years, companies have not been allowed to fully recover the rise in input cost and freight. The recent decision of the Government to increase capacity utilisation norms for gas-based fertiliser plants to 90% from the second to the tenth year of operation and 85% from the eleventh year onwards has already made the situation bad.

Agricultural use of DDT banned

The Government has banned the use of dichloro diphenyl trichloroethane (DDT) in agriculture. The use of the pesticide for the national health programme would however continue with a limit of 10,000 tonnes per annum.

DDT, perhaps the cheapest pesticide available, has been in use in the country for both agricultural purposes and the national health programme for the last 40 years. The state-owned Hindustan Insecticides Ltd. is the only manufacturer of DDT in the country from its three plants. The Government has already directed the manufacturers of DDT, both the technical and formulations, to return their manufacturing licences according to informed sources.

Manufacturers are also directed that no product of DDT should be manufactured or imported. Any manufacture or import henceforth would be contravention of the Central Insecticides Act and rules thereunder. The decision to allow the use of DDT in a restricted manner for the public health programme will be until an acceptable substitute is identified by the Ministry of Health. However, a periodical review of its use would be undertaken. The sources say that the decision to ban and restrict the use of DDT in the country is in the context of the recommendations of an expert committee constituted by the Union Ministry of Agriculture to examine the utility of pesticides banned or phased out or restricted in developed countries and to give suggestions in regard to safer substitutes.

One of the insecticides reviewed by this committee was DDT as it has been banned or restricted in many developed countries but is still being used in India. The use of DDT has been totally banned in the US, EEC and 15 other developed and developing countries. About 20,000 tonnes of DDT used to be sprayed in different parts of the country by the Government agencies under the programme (NMEP). In agriculture the use is limited to about 1,000 tonnes in a year.

Till today about 2,80,000 tonnes of DDT have been used in the public health programme and nearly 50,000 tonnes in the agricultural sector. According to a survey the DDT residues are present in various components in the environment. Although residues of DDT in human tissues have been shown to be present since 1965, in India as yet not a single case has been diagnosed suggesting death as a result of heavy DDT residues. Although the use of DDT is banned for agricultural use and restricted for the health programme, the possibility of a steady increase in residue accumulation in human beings is quite strong.

This is because DDT residues a[re] non-bio-degradable and have a tenden[cy] to accumulate in human tissues. Studi[es] have shown that DDT residues could b[e] carcinogenic in the long run. The sou[r]ces fear that the ban on the use of DD[T] in agriculture may not be foolproof a[s] there is a possibility of pilferage of DD[T] meant for the purpose of public healt[h] to the agricultural sector. As it is in sev[er]eral parts of the country spraying o[f] DDT for malaria control is found to be totally ineffective as the mosquitoes have developed 'triple resistance' because of the continued use the, sources say.

RAASHI FERTILISERS

Raashi Fertilisers has received a letter of intent for manufacture of one lakh tonnes per annum of sulphuric acid with all its variations. The exact location and technical arrangements as well as financial arrangements are being worked out. According to Mr. C.J. Ramsinghani, Chairman, the company has got good demand growth potential and its stock position always minimum. The production is booked much in advance. The company's SSP has penetrated the market in Nasik and surrounding districts so that the company's production is not keeping pace with growing demand.

Organisational group to study ONGC recast

An organisational development group (ODG) has been set up to review the present monolith structure of Oil and Natural Gas Commission (ONGC) and suggested its possible restructuring into subsidiaries.

According to official sources, ODG is expected to study ONGC's re-organisation, organisations of other public and private sectors in India also some of the companies abroad and come out with broad strategies on organisational development. The group will work on a variety of assignments right from standardisation of office management systems to various complex organisational development issues faced by ONGC.

The group will also act as a think-tank and review and modify proposals submitted by various groups and agencies within the organisation. The main thrust of the organisational group, however, will be in suggesting strategies for formation of subsidiaries, installation of formal management control systems, establishment of joint venture, diversifications and human resource development strategies for ONGC.

The need to revamp the ONGC organisation structure has been felt in view of its expanding activities. In terms of crude oil and gas production, the range of exploration work, the number of rigs mobilised and the anticipated quantum of investment, the Eighth Plan envisages a massive programme of growth.

Since 1980-81, the production of crude oil and oil equivalent of gas by ONGC has increased from 10.8 million tonnes in 1980-81 to 45.41 million tonnes of oil and oil equivalent of gas in 1989-90. This is projected to increase further to about 78 million tonnes oil and oil equivalent of gas by 1994-95. The number of rigs have increased from 41 in 1980-81 to 143 at present, which is expected to increase to 221 by 1994-95.

Contribution by ONGC to the exchequer has increased from Rs. 141.35 crores in 1980-81 to Rs. 3,487 crores in 1988-89. The profit after tax has increased from Rs. 141.35 crores in 1980-81 to Rs. 1,601.58 crores in 1988-89. This is despite the fact that the price payable to ONGC has remained stagnant since July 1981. In fact, the sub group on exploration and production set up by the Planning Commission has recommended a hike in the price of crude payable to the oil producing companies.

Meanwhile, ONGC has turned up an impressive performance for the first six months of the current financial year. It has surpassed the targets set for the six month period April to September this year. With a crude production of 15.6 million tonnes during April-September this year, the targets for oil production have been fully met with.

Compared to the corresponding achievement for 1988-89, the increase in crude oil production works out to about one million tonnes. The total crude oil production target during 1989-90 has been put at 31.61 million tonnes as compared to 29.64 million tonnes in 1988-89. Similarly, the target for gas supplies have also been achieved, with supplies registering a 26% growth over the corresponding period of last year.

The achievements in the geological seismic surveys and drilling front have been equally encouraging. The onland seismic survey targets for the first six months of the year for 2D and 3D surveys have been surpassed by as much as 85% and 30% respectively. The onshore and offshore drilling achievement has shown an improvement of 37% over the last year.

There has been a 101% achievement in the drilling cycle speed (metres/rig month) targets. For the current six monthly period as compared to the corresponding period last year it shows an increase of 19%. As many as 20 rigs have been inducted into ONGC fleet taking the total rig count to 143.

TN TOLD TO INVEST RS. 6,300 CR. IN PETROCHEM INDUSTRIES

It has been proposed that Tamil Nadu should make a massive investment of Rs. 6,300 crore over the next 10 years in "core petrochemical industries" to gain a footing in the field.

At present, the State's share in the country's installed capacity for production of petrochemicals is a meagre 5.9%. The major items produced in the State are polyvinyl chloride, PFY, PSF, nylon tyre cord and LAB.

According to an official paper, the investment outlay can be spread over two phases, one covering the Eighth Plan with Rs. 3,000 crore and the other during the Ninth Plan period with Rs. 3,300 crores.

It is estimated that Tamil Nadu can easily contribute 15-20 per cent of the total demand for three major divisions of the industry, namely, polymers, fibres and chemicals, as projected by the Kapoor Committee for the period till the turn of the century.

The field is now dominated by Maharashtra and Gujarat by virtue of their proximity to the feedstocks like oil, gas and naphtha. More recently, Uttar Pradesh has also entered the scene by bagging the Salimpur Aromatic Complex and Auriya Gas Cracker Project.

The first phase envisages setting up of 'mother units' for production of building blocks (aromatics and olefins) and bulk petrochemicals. Fortunately, an aromatic complex in the joint sector

has already been cleared for the State. It is argued that the project should come up fast so that it goes on stream by 1995.

Simultaneously, an exclusive port terminal with a separate jetty should be created for handling building blocks and intermediate chemicals. This will require developing a separate approach waterway and harbour and adequate storage facilities within the framework of safety and environmental standards.

It has also been suggested that plants for production of a host of bulk petrochemicals to be set up in the first phase itself, taking cognisance of the minimum economic size norms recently laid down by the Union Government.

It is pointed out that the Union Department of Chemicals and Petrochemicals has targeted an allocation of Rs. 15,000 crore for the Eighth Plan. It should not be difficult for Tamil Nadu to get a pro-rata share of 20% in the outlay.

In the second phase covering 1995-2000, another mother unit for olefins is sought to be implemented.

Besides, an integrated refinery, based on either oil available in the Cauvery basin or imported oil should be set up solely to provide feedstocks for the petrochemicals industry.

These apart, a naphtha-cum-gas cracker and a propane dehydrogenation units are to be established. There is also scope to promote additional bulk petrochemical plants based on the outputs of the naphtha cracker and dehydrogenation facilities.

NEW UK OILFIELD HAS 100 MILLION BARREL POTENTIAL

Appraisal drilling on an oil discovery to the east of the Piper field in the British sector of the North Sea has confirmed the presence of high quality oil, with estimated recoverable reserves amounting to about 100 million barrels. Occidental Petroleum (Caledonia) Ltd. has recently completed drilling two wells to find the eastern limit of the field and evaluate the extent of recoverable oil in East Piper, which was discovered in January 1988.

Occidental's UK Chairman, Mr. John Brading, said the appraisal drilling programme has significantly increased the company's estimate of the field's recoverable reserves.

One appraisal well was drilled by the semi-submersible rig Sonat Disilyn Field 96 and showed an oil flow at the stabilised rate of 6,270 barrels per day through a 142/162 cm choke.

The oil has specific gravity of 40.6 Degrees A.P.I. and a gas-to-oil ratio of 11.3 cubic metres per stock tank barrel. The well was drilled to a total measured depth of 3,280 metres.

Drilling of the second appraisal well by the semi-submersible rig ocean Benloyal to test the extent of the field revealed oil-bearing sands and was suspended without testing.

East Piper lies roughly eight kilometres from the Occidental Consortium's pipeline system which will be used to transport production from the new field to the Flotta Oil Terminal (Orkney). Flotta Terminal currently handles 10 per cent of the UK's oil output.

Interests in the East Piper discovery, the pipeline system and the Flotta Oil Terminal are held by Occidental Petroleum (Caledonia) Limited, in conjunction with Texaco Britain Limited, LASMO North Sea PLC and Union Texas Petroleum Ltd.

In July, this group announced discovery of another new oilfield in the British North Sea, north-west of the Claymore production platform, where a first appraisal well will be drilled later this year.

ONGC plan to raise Cauvery Basin production 10-fold

With the recent successful oil strike at Adiyakkamangalam in Thanjavur District, Oil and Natural Gas Commission (ONGC) is aiming at a ten-fold increase in production from Cauvery field during the Eighth Plan. The target of oil production by the end of the current year from Cauvery field has been put as 0.2 million tonnes.

ONGC plans to produce about two million tonnes per annum in 1994-95 the terminal year of the Eighth Plan. The free and associated gas production potential would by that time reach a level of 2.03 million cubic metres per day. Oil was struck at a well in Adiyakkamangalam on August 31, this year. During testing the well indicated a prolific rate of 600 barrels per day of oil and one lakh cubic metres of gas.

The present rate of production from the Cauvery Basin is about 4,100 barrels per day (685 tonnes per day) from the wells at Narimanam, Bhuvanagiri and Nannilam. The cumulative production from the basin has been 95,200 tonnes.

Cauvery Basin has now been upgraded as Category-I, that is on par with the commercially producing basins like Cambay, Upper Assam and Bombay offshore. Since 1985, five discoveries of oil and gas have been made in the Cauvery Basin onland.

Major hydrocarbon strikes have been made at Kovilkalappal, Narimanam and Nannilam in Thanjavur district, and Bhuvanagiri in the South Arcot district. In the offshore, a significant discovery has been made at the PY-3 and PY-1 structure in the Porto Novo area.

The Narimanam discovery made in July 1985 was the first to be hooked up to EPS within eight months of the discovery. Presently 19 wells have proved hydrocarbon bearing in this prospect in land. A group of seven wells have already been hooked up to a group-gathering station.

A total development scheme for this prospect is being presently worked out at the Institute of Reservoir Studies. Further exploration also is going on simultaneously in this area. ONGC plans to delineate the Adiyakkamangalam prospect. One more well will be drilled in the same area. Two more locations have been firmed up to explore oil for knowing the extent of oil-bearing area in this field. These locations would be taken up for drilling on priority.

ONGC is presently drilling at Narimanam, Thirukada-structure offshore. Nine rigs have been presently deployed in the onland and offshore Cauvery Basin. A number of other exploratory locations with similar objectives have been identified after critical review and they will be taken up for drilling. By the end of the next Plan (1994-95) the total number of rigs is expected to be 16.

Tamil Nadu is presently facing power shortage. The availability of gas from the region can change the power generation scenario in the State. Already ONGC has committed 40,000 cubic metre of gas per day to be supplied to TNEB for generation of five mw of power by the first quarter of 1990-91. TNEB has also registered a demand for the offshore gas to set up a 100-mw power plant at Cuddalore.

From Narimanam a commitment of over one lakh cubic metres of gas per day has been made to nine consumers. Gas to the extent of about 14,000 cubic metres per day is already being supplied through the 18 km pipeline to the various industries located near Nagapattinam.

Gas demand to the extent of five million cubic metres per day has also been received by various industries engaged in manufacturing fertilisers, glass, ceramic, textiles, cement and petrochemicals from the Bhuvanagiri area.

DEVELOPMENT AGENCY FOR PETROCHEMICALS

The Union Government has set up an agency under the Chairmanship of the Secretary, Department of Chemicals and Petrochemicals, for the promotion and development of the petrochemical industry.

An autonomous body under the administrative control of the Department of Chemicals and Petrochemicals, the Petrochemical Promotion and Development Agency (PPDA) is to be a registered society under the Societies Act with its headquarters in Delhi.

The agency is governed by a governing council comprising 14 members including the Chairman who is the Secretary in the Department of Chemicals and Petrochemicals. The main function of the agency, according to an official release at New Delhi on September 6., is to identify and support the development of basic petrochemicals and their end-products in areas relevant to the present and future needs of the economy.

For fulfilment of its overall role and responsibilities, PPDA will set up three specialised groups to deal with polymers, fibres and chemicals respectively and powers will be delegated to them. Each group will be given budgetary support by the agency for formulating specific tasks and action plans. An initial seed money of Rs. 25 lakhs for a period of three years is to be provided by the Government as Plan expenditure.

As for polymers, the release said PPDA would interact through the concerned group with Indian Petrochemicals Corporation Ltd., the Central Institute of Plastic Engineering Technology (CIPET) and the National

Committee on Plastic Applications (NCPA) in respect of specialised plastic application areas in automobiles, teletronics, building construction and agriculture. Another cell is to be set up under the agency to exclusively look into the need for futuristic application of petrochemicals in vital sectors like space, marine, defence and biomedicine.

Besides the Chairman, the other members of the governing council are representatives from the Department of Chemicals and Petrochemicals, the Central Board of Excise and Customs (CBEC) of the Finance Ministry, Planning Commission, the Directorate General of Technical Development (DGTD), the Oil Industry Development Board/Ministry of Petroleum and Natural Gas and the Chairman and Managing Director of IPCL.

The remaining comprise one expert each from polymers, synthetic fibres, chemicals, one representative from the consumer industry, an economist, an academician related to the petrochemical industry and a nominee of the chairman. The agency will have a secretariat with an executive director as its head. It is to be funded through contributions from the major units of the petrochemical industry including public sector undertakings and the Oil Industry Development Board.

Among the other functions of PPDA is to suggest policy measures and support the programmes likely to benefit the small scale producers and converters and recommend to the Government such measures including appropriate export/import and fiscal policies as may be required to help the industry in keeping with the overall national objectives.

STONE LAID FOR GANDHAR PETROCHEM PROJECT

The Prime Minister, Mr. Rajiv Gandhi, on October 6, laid the foundation stone for the Rs. 2,300-crore gas-based petrochemical complex of the Indian Petrochemical Corporation Ltd. (IPCL) at Gandhar in Baroach district.

Addressing a public meeting at Dahej, the Prime Minister said that with the setting up of the petrochemical complex, the face of this backward district will be changed in the next three years. It will also help in setting up a number of downstream units in this area, he added.

The project will require 8 million cubic metre gas per day and will be based on Gandhar oil fields. The foreign exchange to the tune of Rs. 750 crores will be required for the project.

For a growing economy like ours materials like plastics are very much needed, Mr. Gandhi said. He said that plastics are not just for toys and household goods but is also used for agricultural applications and to high technology areas.

He assured that the Government would do everything possible to try and achieve completion of the project in the fastest possible time. Earlier, Mr. Hasmukh Shah, IPCL's Chairman-cum-Managing Director, explained the features of the complex and assured the Prime Minister of every effort in completing the complex within four years.

He said IPCL has taken up an afforestation programme involving 20 lakh trees spread over 5,000 acres in the wasteland areas of Gandhar. He also announced the setting up of a training institute in this area.

Petrofils Project

Mr. Gandhi, dedicated to the nation the Rs. 120-crore nylon-6 plant of Petrofils, the only synthetic filament plant in the co-operative sector, in Valia taluka of Broach district. The project was completed six months ahead of schedule. A producer of polyester filament yarn since 1977, Petrofils is well known for its quality and the development oriented customer service.

It is also known for its role in bringing about the price stability in the ever fluctuating market. The capacity utilisation of its polyester plant has been more than 100% since 1982 and had reached an all time high of 146% in 1988-89.

$ 84 M JAPANESE EXIM BANK LOAN FOR IPCL

Japan's Export Import Bank announced a 12 billion yen (84 million dollar) loan to the Indian Petrochemicals Corporation Ltd. on October 6.

The loan fund is part of a joint financing package to which the World Bank is also a party, the Japanese Exim Bank said in its announcement. The fund is to go to finance a petrochemical project in Maharashtra, the bank said without giving details on streams of the loan.

MoU FOR INSECT REPELLANT

A memorandum of understanding was signed in Delhi between Defence Research and Development Establishment (DRDE) Gwalior and Coramandel Indag Products India Ltd. for the transfer of technology and commercial production of diethyl phenyl acetamide (DEPA), an effective insect repellant.

The new chemical has undergone extensive toxicological studies in the laboratory and field tests in different places in Army, Air Force and Naval stations under the supervision of station health officers. DEPA was approved by the chiefs of staff committee as a replacement of dimethyl phthalate (DMP), which is being used at present.

The chemical is three times more effective than DMP and is produced from indigenously available chemicals by a process developed by DRDE. The Drug Controller, India has approved the chemical and issued a manufacturing licence.

Highlights in Chemical Technology (Part 2)

THE GREENING OF RECYCLING TECHNOLOGY

Every species limits its growth by starvation or self-poisoning. Technology in the form of green revolution may rescue mankind from the former, but our garbage may yet poison mankind. One way to minimize the pollution from garbage is to recycle paper products, glass, metals, and compostable agricultural products. In big cities, in USA, recycling has been slow to catch on, remaining the province of those with an environmentalist bent. That is probably true in other large cities as well. But in many smaller cities of USA recycling has come of age. The question to ask now is 'How can I make money by using this virtually free feedstock?' This is the challenge to chemists and biotechnologists. (*Tech Rev.* 1987, 28, *Chemtech* 1/1989 p.p. 2-3).

SILICON TO CHALLENGE CARBON'S DOMINANCE

Polymers based on silicon, rather than carbon, may emerge from a research project to be set up in Japan. The new materials will be as versatile as today's petrochemicals, but they will be tougher, more resistant to heat and will display many useful optical as well as electronic properties.

Japan's MITI is planning to launch the project, which will involve private companies and university researchers in 1990. In August last year, it set up a chit of 11 private companies, who were interested in the idea. The Ministry plans to spend about 16 billion yen (£70 million) on the project over 10 years.

The main goal of the research project is to develop new processes for forming silicon polymers from monomers. So far, efforts to do this have produced disappointing results. However, Sir George Porter, President of Britain's Royal Society, has predicted that silicon (Si) will replace carbon as fundamental industrial material in the 21st century.

Silicon falls next to carbon in the periodic table and can form compounds in similar ways. However, polymers based on silicon are expected to be tougher and better at resisting heat. There is little danger of the raw material running out. (*New Sci.*, 6/10/89, p. 36).

CLEAR UNIFORM PARTICLE SIZE POWDERED DIAMOND PRODUCED BY A VAPOUR PRECIPITATION

Scientists at Pennsylvania State University (University Park) and Diamond Materials (State College, PA) have manufactured recently diamond powder with a vapour precipitation process that ignites a hydrocarbon in oxygen and energizes the plasma with microwaves.

While commercially available diamond powder is cheap, it is non-uniform in particle size and dirty, often containing mineral impurities. With the new process, on the other hand, one can control purity and particle size as well. (*Chem Wk.*, 7/19/89, p. 38).

UNION CARBIDE UNVEILS A NEW COATING DELIVERY SYSTEM FOR PAINT BASED ON SUPERCRITICAL CARBON DIOXIDE

Carbon dioxide brought to its supercritical point — where it remains a gas but acts like a liquid — is at the heart of a new coating delivery system developed by Union Carbide researchers at its Danbury CT Laboratory. The researchers report that for every gallon of coatings sprayed by present methods, 4.5 pounds of solvents are released. But with the new technology, supercritical CO_2 replaces much of the solvent, which lowers the viscosity of the coating so it can be sprayed. The paint and the gas, at 88° F and about 1,200 psi, are blended by a static mixer and sent directly to the spray gun.

Union Carbide will undertake industrial trial by the 3rd quarter of 1989 and the technology will be commercially available by the end of 1989.

The company claims that the new coating delivery system reduces solvent emissions, flammability and CO_2 pollution because it uses byproduct gas from other processess. The company will license only the technology and will not manufacture paint equipment or gas. (*Chem Wk.*, 7/26/89, p. 38).

RHONE POULENC GETS AN EXCLUSIVE LICENCE TO MANUFACTURE AND MARKET CYCLODEXTRINS

Rhone Poulenc (France) a leading chemical giant, has recently acquired an exclusive license for the manufacture and marketing of cyclodextrins from the Rinker Institute and Nihon Shokuhin Kako (Japanese manufacturer of maize products). This contract covers W. Europe, North and South America.

Cyclodextrins are cyclic oligosaccharides derived from starch by enzymatic action. They have certain novel properties which make it possible to stabilise and protect active molecules, reduce the volatility of flavourings and fragrances or to mask unpleasant tastes/odours., (*Mfg. Chemist*, 7/1989, p. 8).

BASF — WORLD'S BIGGEST CHEMICAL GROUP UNVEILS NEW LANDMARKS IN CHEMISTRY

BASF (Ludwigshafen, W. Germany), currently ranked the biggest chemical group in the world and claiming the most comprehensive plastics range is unveiling a suitably large presentation

for K'89, the Triennial Plastic Fair to be held in Dusseldorf in November 1989.

One product the company will highlight is a new polystyrene polyethylene polymer blend for food packaging. The 50:50 material is aimed at applications where moisture-loss prevention is critical, and uses a new proprietary compatibilizer to blend the two polymers.

In polyurethane foam, BASF is pushing the chlorofluorocarbon-free foams, which are blown with water and incorporate melamine to improve flame retardancy. Other work on CFCs includes adapting systems to use pentane and halving CFC use in refrigerator foams.

BASF has a new nylon-6 resin that melts as high as 572° F and has good mechanical properties.

BASF projects medium term annual growth for PVC at 2%, low density and linear low density polyethylene at 2.5%, polyurethanes at 3%, high density polyethylene at 4.5%, polypropylene at 5% and engineering resins overall at 5.5% with high-temperature resistant plastics and liquid crystal polymers showing double digit growth. (*Chem Wk.*, 7/26/89, p. 38).

THE WORLD'S FIRST CONTINUOUS AROMATIC FLUORINE INTERMEDIATE PLANT INAUGURATED BY MALLINCKRODT SPECIALITY CHEMICAL COMPANY, USA

A fully continuous aromatic fluorine intermediate plant — the world's first, according to the plants designer M.W. Kellogg Co. (Houston) — was started up recently by Mallinckrodt Specialty Chemicals Co. in St. Louis.

Compared with batch routes, the technique has 30-50% lower capital costs and about 10-20% greater yield and fewer hazards for aromatic fluorine intermediates. An aromatic amine (e.g. aniline) is reacted with hydrogen fluoride, in a reactor of proprietary design, to continuously make an aromatic fluorine via a two-step process — diazotisation of the amine, followed by decomposition of the diazonium salt to fluorobenzene. The latter step is exothermic and gives off nitrogen gas. Hazards are lessened because the process is carried out continuously, which reduces inventories of hazardous materials, and because it requires a smaller volume of raw material than a batch process for the same capacity plant. (*Chem Engg.*, 6/1989, p. 23).

GRAPHITE EPOXY — A NEW MATERIAL FOR HIGH-TECH COMPOSITES

Graphite epoxy — a lightweight, stiff and durable material that absorbs radar and sound waves — is coming into widespread use in the high-tech composites employed in the aerospace and defence industries, reports the National Institute of Standards & Technology (Gaithersburg, MD). The NIST notes the product is used on the Air Force's Stealth Bomber and might also be used in navy submarines.

Scientists at NIST are working up non-destructive test methods to study stress and strain in this and other composites. They are using supercomputers to model the composites' behaviour and converting the results into graphic representations of stress waves running through the material. By converting to a movie' says Richard D. Driz, a research engineer in the Fracture & Deformation Division, 'we are able to confirm what has been assumed about wave propagation but never visualized before'. (*Chem Wk.*, 5/17/89, p. 24).

SHELL'S NEW COAL GASIFICATION PROCESS GETS READY FOR COMMERCIAL TRYOUT

Shell's coal gasification process is scheduled for its first commercial tryout in a 250 MW, combined cycle power plant to be started up in 1993 at Buggenum (Netherlands). Engineering firm Comprimo B.V. (Amsterdam) recommended the route over competing methods proposed by Texaco and British Gas/Lurgi because of greater flexibility in the use of different types of coal, slightly lower electricity production costs and good possibilities for scaleup.

Shell's new process is distinguished by its dry feed system — coal is pulverised and fed pneumatically under pressure, rather than mixed with water and fed as slurry as in other routes.

The process reacts dry coal with oxygen and steam in an entrained, slagging gasifier at 1,300-1,700° C and 20-25 bar to produce a medium Btu gas (about 300 Btu/scf). The gas is fired in a gas turbine and can be used as electric-generating fuel or a petrochemical feedstock.

Shell has demonstrated the process previously at Amsterdam, Hamburg, West Germany and Deer Park, Texas. Comprimo is slated to complete basic design of the 1900 ton/day Buggenum unit, which will be operated by Demlolec (Arnheim), the Dutch Electricity Generating Board, by the end of 1989. (*Chem Engg.*, 7/1989, p. 17).

NEW CATALYSTS DEVELOPED FOR DESTROYING VOLATILE ORGANICS AT LOWER INCINERATION TEMPERATURES

New catalysts for destroying volatile organics at lower incineration temperatures have been recently unveiled by George Lester, a Senior Research Engineer at Allied Signal Engineered Materials Research Centre (Des Plaines, Ill, USA) at the AWMA meeting.

These new catalysts are reported to be more active, stable and insensitive to inhibition by halogens than are conventional supported noble metal or

hromic-alumina catalysts. These catlysts are described as 'proprietary alohydrocarbon destruction catalysts HDCs)' and include both noble and on-noble metals, the particular one lepending on the application.

These catalysts, in pellet form or coated on a monolithic ceramic support have been tested for the incineration of various chlorinated and fluorinated hydrocarbons. The HDCs achieved better than 99% destruction of CCl at about 335° C vs 535° C for a chromic-alumina reference catalyst. Destruction of benzene required only 225° C vs 490° C for Cr-Al. So far, the catalysts have been tested only in laboratory, but arrangements are being made with incinerator manufacturers for field tests. (*Chem Engg.*, 7/1989, p.p. 19-21).

A LASER-BASED CHEMICAL VAPOR-DEPOSITION PROCESS FOR PRODUCTION OF CERAMIC FIBRES MAKES A DEBUT IN USA

A laser-based chemical vapour-deposition process to make ceramic fibres in specific sizes, shapes and with uniform properties has been recently developed by Ceramic Research Inc. (Kansas City, MO, USA). The new process claims several benefits over regular chemical-vapour deposition:

(a) Material growth rates up to 1 mm/sec. are several-hundred fold higher.

(b) There are no chemical interactions between the deposited ceramic and a substrate, since no substrate is used.

(c) And the process operates over a wider range of temperatures and pressures, allowing new materials to be made.

In the process, chemical vapours enter a reactor, when lasers provide the energy needed to react the materials and instantly produce a continuous fibre. Boron and silicon carbide fibres as well as novel amorphous, polycrystalline and single - crystal ceramic materials, can be produced. The process will be commericialised by Du Pont Co. (Wilmington, Delaware), which last June acquired the patent rights. (*Chem Engg.*, 7/1989, p.p. 17-19).

A NEW LIGHT-WEIGHT, LOW-COST INSULATING MATERIAL MAKES A DEBUT IN USA

Researchers at Battelle (Columbus, Ohio) are working with Thermalon Industries (Harbour City, CA) to bring a new thermal insulation material being developed by the California firm to commercial readiness. Thermalon came up with a process to take 0.5 mil. film — made of polypropylene or polyethylene terephthalate, for example — slit it, put it under a tension to form a honeycomb structure and then thermally set it.

The two companies researchers are now trying to find the best plastics for the insulation. In addition to PP and PET, they are looking at such materials as Tedlar (Du Pont's polyvinyl fluoride), nylons and polyimides. The researchers report that the linings have very good thermal insulating properties. This light weight low-cost insulating material will be used to fill fabrics for coats, ski pants and sleeping bags, as well as other applications. (*Chem Wk.*, 7/19/89, p. 38).

A NEW SUPERIOR TEFLON FROM DU PONT

Fifty one years after the discovery of 'Teflon' Du Pont (USA) has developed a new fluoropolymer for high-technology coating, including computers and fibre optics.

Called 'Teflon AF', the fluoropolymer has optical, heat and electrical characteristics that far exceed the current polymer grades of 'Teflon' but without the slipperiness and creep, making it well suited for electronics, telecommunications, chemicals, military/defence; aerospace and biomedical industries.

Teflon AF has the lowest known dielectric constant of all plastics (1.89-1.93), low moisture absorbance, good dimensional stability and temperature resistance up to 300° C.

Because of the optical characteristics of the product, Mitsubishi Rayon is developing high-temperature plastics optical fibres under an exclusive agreement with Du Pont.

Du Pont reports it is also investigating other uses for the polymers in advanced applications and is working closely with engineers in a variety of industries. Sales could reach about $ 50 million/year after profits are realised in about 5 years. Teflon AF will be priced about 75 to 100 times higher than existing grades of Teflon. (*CMR*, 6/26/89, p. 13).

A PROCESS TO MAKE SILICON METAL FROM SAND ON THE HORIZON

Dow Corning Corporation claims good progress is being made on a major research project to determine the technical and economic feasibility of a new way to manufacuture silicon metal —a key raw material in the manufacture of silicone materials.

The research programme, being conducted jointly with the Manitoba Energy Authority with financial assistance from the Canadian Government, has achieved success in the initial research phase and Dow Corning is continuing on a path toward construction of a $ 10 million pilot plant.

In the initial phase, samples of Manitoba silica sand were tested at a plasma furnace in Linz, Austria and the results were favourable. If the current phase of work is completed successfully, the pilot plant would be constructed in 1990. Such a pilot plant would use approximately three rail cars per week of raw materials such as charcoal and sand. These raw materials will be electrically

heated utilising plasma technology, which is an efficient way to convert electricity to heat. The product silicon would be shipped by rail at a rate of one car every 10 days. (*CMR*, 6/5/89, p. 7).

A NEW PU FOAM PROCESS WITHOUT CHLOROFLUORO-CARBON UNVEILED

Thanex Chemie (Viersen, W. Germany) has recently unveiled a blow moulding process for polyurethane foam, using air instead of chlorofluorocarbons as the blowing agent. According to the company, insulation sheets produced using the new process are being marketed solely in the UK, where they have been certified as CFC-free and have been approved by building authorities. As the sheets are not as effective as CFC-blown material, they need to be thicker. They also cost about 25% more to produce. Polyurethane producers Bayer and BASF are sceptical if the new sheets can perform the function required of them. Bayer reports it has tried a CFC-free blow-moulding process, but it proved to be uneconomical. (*ECN*, 7/24/89, p. 12).

OPTIRAY (LOVERSOL) — A NEW NONIONIC CONTRAST MEDIUM FOR RADIOLOGY & CARDIOLOGY

International Minerals & Chemicals Corporation (Mallinckrodt's medical unit) of St. Louis, Miss, USA has developed and marketed 'Optiray' (Chemical name'Loversol') a new nonionic contrast medium for radiology and cardiology.

The new contrast medium was approved by FDA in December 1988. It is the first nonionic contrast medium to be developed, patented and marketed by a US pharmaceutical company.

Nonionic agents having low osmotality are reported to improve patient tolerance — causing less heat and pain than conventional ionic contrast media.

Optiray is indicated for uses including computerised tomography (CT) scans to visualise organs and major blood vessels, urography or X-ray examination of the kidneys and urinary tract, and all major angiography procedures in which arteries and veins are visualised.

An increasing portion of the rapidly growing contrast media market in USA is shifting to new generation, low osmotality products both nonionic and ionic.

The US market for x-ray contrast media is about $ 500 million annually and may reach $ 1 billion by 1993. The worldwide market is well over twice that of the USA.

Optiray will be also marketed in some European countries, as well as Canada, Australia and Japan in the near future. (*CMR*, 6/5/89, p. 13).

A NEW PROCESS TO RECOVER PHOSPHATE FERTILISER FROM WASTEWATER SLUDGE

A process that recovers phosphates from wastewater treatment sludges and converts them into usable fertiliser has been developed in West Germany, according to researchers working at the Technical University of Berlin.

The sludge is first treated with hydrogen sulfide to resolubilise the phosphates. After centrifugation, the soluble portion is treated with calcium hydroxide to produce calcium phosphate, which can be used as fertiliser.

The solid portion is treated with HCl to bring the iron into solution, which is recycled for use in the phosphate precipitation step in the waste water treatment plant. Remaining heavy metal sludges can be landfilled or incinerated.

Prof. Wilhelm Ripl at the University reports the process already is economically competitive with the cost of the dewatering and landfilling. (*Chem Wk.*, 143 (7) 1988, 16).

MATERIALS MANAGEMENT

Part IX - Inventory and its Control (Contd.)

N.R. PAI

PRACTICAL INVENTORY MODELS

The simple EOQ model which we dealt with in our previous communication (M.M. part VIII, C. W. of 19.9.89) is:

$$Q_{Eco} = \sqrt{\frac{2AC}{PE}}$$

where

A = Fixed annual demand
C = Cost per order
P = Price of each unit and
E = Managements estimate of annual carrying cost expressed as percentage of P.

It has three assumptions viz. 1) annual demand is known with certainty, 2) rate of depletion of inventory is constant, and 3) exact lead-time is known. However, these are ideal situations and they may not exist in most of the practical cases. In fact, in actual practice many uncertainties prevail and the materials manager has to work after taking into consideration lot of contingencies.

The problems mainly arise because of two factors: a) lead time may not be constant and it may step up any time, b) the rate of consumption may vary. It may rise without notice which in turn tends to lead to "stock out" situation. We have then to take care of these two variations and this leads us to what are known as "Practical Inventory Models". The only answer to the above fluctuations is to maintain safety, buffer and reserve stocks and this fact is embodied in these modified models.

Often for the sake of convenience and clear understanding these three stocks are given separate meaning: 1) **Buffer** stock is meant to take care of stocks during normal consumption, lead-time remaining undeviated from its normal value. 2) **Safety stock** looks after average consumption with increase in lead-time i.e. when the lead time is prolonged beyond the normal value that is set for it. 3) **Reserve stock** takes care of rise in consumption rate with lead time remaining normal.

Statistical methods are employed to take care of these fluctuations in rate of consumption and of lead-time deviations. Fluctuations in consumption rate can be rectified by referring to average rate of consumption for a particular period and applying correction to it by way of standard deviation during this period. So far as lead-time variations are concerned, average lead-time is first looked into and correction to it can be applied by referring to the probability of maximum rise in it from its normal value.

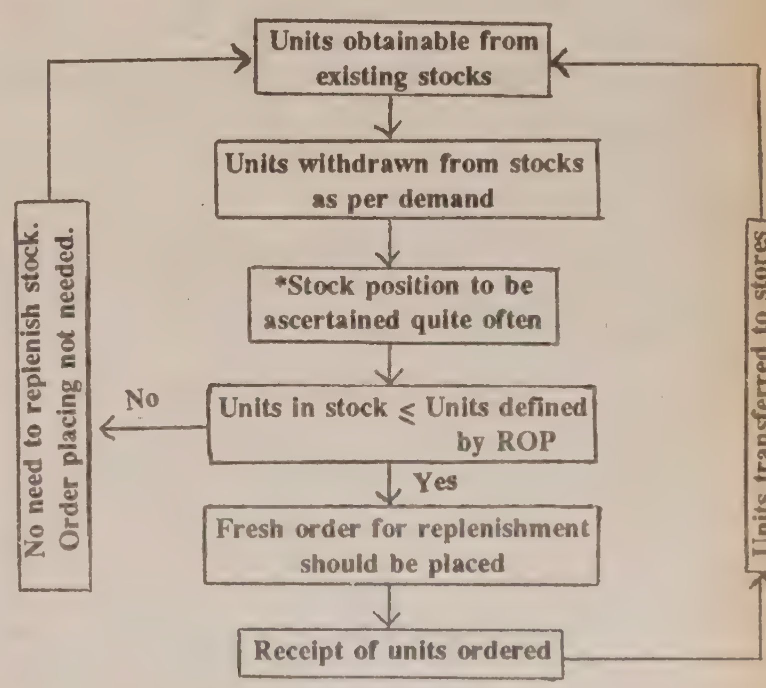
The above two points are with respect to safety stock and reserve stock. Buffer stock calculations are simple that way since it has to take care of normal consumption when lead-time remains undeviated from its normal value. This figure can be arrived at first by multiplying normal consumption rate with normal lead time.

It goes without saying that correction figures for these fluctuations can be ascertained by referring to previous records. With this background we can now proceed to go in for: 'Q' system and 'P' system of practical inventory models.

Q-system

It is referred to as "Fixed Quantity System". Here quantity per order (Q) is fixed or every replenishment. It is also known as "perpetual inventory system" and the number of units ordered every time always remains constant. What varies here is the time between the orders due to fluctuations in usage. As soon as inventory level drops down to the Reorder Point (ROP) fresh order is placed for a fixed number of items. This system therefore needs a continuous check on the inventory level. The fixed quantity to be ordered every time is defined by EOQ. For fixing ROP level all the three (safety, buffer and reserve) stocks are taken into consideration.

The working of this system can be charted out as shown here below.



Q-System Chart

*Note: While determining stock position materials manager has to look into two points: actual stock in stores popularly

known as "stock on hand" and secondly the number of units already ordered but not received. The combination of the two is often referred to as "virtual stock".

P-System

It is also known as T-system or fixed order interval system or periodic inventory system. Here the fixed factor is the period between the two successive orders and the variable factor is the quantity per order (Q_s). Here maximum inventory level for each item is determined and therefrom all replenishment orders are worked out. After a fixed interval of time (T) the stock position of each item is ascertained. Fresh order can then be placed for replenishment. The quantity for order fluctuates depending upon variations in usage rate between two successive order points.

The quantity per order for each item = maximum inventory level fixed for it — its existing stock situation.

Since the time between the two successive orders remains unchanged this system is called 'T' system or 'P' system, 'T' standing for time and 'P' for period.

There is one marked difference between 'Q' system and 'P' system. In 'Q' system we take into account variations in lead-time and fluctuations in consumption rate. But in 'P' system we have also take into account any rise in consumption during the two successive ordering points, in addition to the above two variations. This at once suggests that the average inventory maintained as per 'P' system would certainly be more than that held in 'Q' system. But then there is a decided advantage in 'P' system. Here, there is a reduction of monitoring labour by clustering together orders. This point will be made clear later.

In 'P' system two points need fixing (I) review period and (II) maximum inventory level.

I. Fixing of review period

To fix review period help is sought of EOQ model. From all the foregoing discussion on "Inventory and its control" it can be easily understood that

$$\text{Number of orders in a year} = \frac{\text{Annual demand}}{\text{EOQ}}$$

$$= \text{say } x$$

Then $\frac{1}{x}$ = review period in years

Similarly, $\frac{12}{x}$ = review period in months

and

$\frac{52}{x}$ = review period in weeks

Now, as already seen before,

$$\text{Number of orders per year} = \frac{A}{EOQ} \quad .....(i)$$

where,

= Annual demand

$$\text{Review period in years} = \frac{1}{\text{No. of orders}}$$

$$= \frac{EOQ}{A} \quad .....(ii)$$

But,

$$EOQ = \sqrt{\frac{2AC}{PE}}$$

Substituting this value of EOQ in (ii) above we have,

$$\text{Review period in years} = \frac{\sqrt{\frac{2AC}{PE}}}{A}$$

$$= \frac{1}{A}\sqrt{\frac{2AC}{PE}}$$

$$= \sqrt{\frac{2AC}{PEA^2}}$$

$$= \sqrt{\frac{2C}{PEA}}$$

$$= \frac{\sqrt{\frac{2C}{E}}}{\sqrt{PA}} \quad \text{(by rearrangement)}$$

$$\frac{\text{Constant}}{\sqrt{\text{Value of annual demand}}}$$ (Since C and E both are constant)

Hence the review period is inversely proportional to the square root of the annual consumption value.

This fact enables us to take together the review of items that have close values of annual consumption. For example, consider three items with similar values of their annual consumption. Say,

item X with value of Rs. 625
item Y with value of Rs. 620
and item Z with value of Rs. 630

Their square roots would be:

$\sqrt{X} = \sqrt{625} = 25$

$\sqrt{Y} = \sqrt{620} = 24.899$

and $\sqrt{Z} = \sqrt{630} = 25.099$

The value of square roots are still closer and hence such items can be easily taken together which in turn would save money because of reduced efforts on labour. This fact clearly suggests that we can apply this method for 'B' and 'C' group items in ABC classification (ref. *C. W. 19.9.89*) where the total value in rupees is less while the number of items to be tackled is quite large. This will naturally free executive time to tackle more efficiently the stock-piling of 'A' group items.

II Fixing of maximum inventory level

Here the stocks are checked after the lapse of the fixed period. At each of these check points actual inventory in hand + quantity expected by way of unfulfilled orders is ascertained. This is called virtual stock.

Then, the quantity to be ordered = Maximum inventory level — Virtual stock.

Maximum inventory level is made up of

1) **Buffer stock** which has to cater to normal consumption during the average lead time as also the consumption during the review period.

∴ Buffer stock = Rate of consumption x (average lead-time + review period)

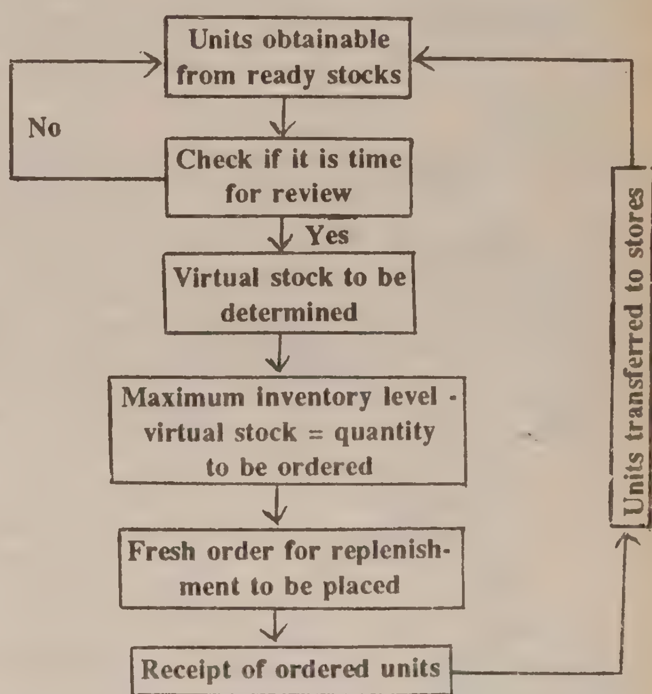
2) **Safety stock** looks after the consumption during prolongation of normal lead-time.

3) **Reserve stock:** This would step us as compared to that in 'Q' system. Since there can be increased consumption during review period and the consumption during the lead time taken together.

The average inventory held in 'P' system is higher than that carried in 'Q' system. Since both buffer stock and reserve stock figures swell up in 'P' system. Naturally the accompanying cost due to this system is more than that of the Q system.

However, P system has three decided advantages: 1) Clustering together all the items for review, which have close values of annual consumption. This as we have noted earlier results in the reduction of monitoring efforts. 2) Time of review is fixed. At that time only stock position is to be ascertained. No need for checking for ROP (Reorder Point) every now and then as in 'Q' system. 3) The greatest advantage of 'P' system is that the buffer and reserve stocks are considered in a more realistic manner since demand during reserve period is also taken into account.

'P' system can be charted out as follows:



P-System chart

'P' system is also known as fixed order interval system or periodic inventory system or T-system. The working of these two systems will be more clear with the help of an example.

Consider an organisation which has one of the items as its raw material with the following data:

1. Item cost per unit = Rs. 4.
2. Its annual demand = 15,000 units.
3. Normal lead time for it = 4 weeks
4. Weekly average consumption of the item = 300 units.
5. Standard deviation from the normal consumption per week = 30 units.

6. Lead time prolongs maximum upto 8 weeks.
7. Probability of such lead time extension = 25%
8. Cost per order = Rs. 30.
9. Carrying cost estimate = 25% per annum.

Let us solve the problem, first by 'Q' and then by 'P' system.

Application of Q system

Here the two points to be looked into: i) EOQ and ii) ROP (Reorder Point).

i) Establishing EOQ

$$EOQ = \sqrt{\frac{2AC}{PE}}$$

$$= \sqrt{\frac{2 \times 15000 \times 30}{4 \times 0.25}}$$

$$= \sqrt{900000}$$

$$= 948.68$$

say **950 units** applying human judgment.

ii) Establishing ROP

ROP is decided with the help of buffer, reserve and safety stocks. Each one of them has to be calculated separately as follows:

Buffer stock = normal weekly requirement x normal lead time in weeks
= 300 x 4
= 1200 units.

Reserve stock

This stock provides for increase in consumption during normal lead time and is given by the product of standard deviation and square root of normal lead time. So we have

$$30 \times \sqrt{4} = 60 \text{ units}$$

Safety stock

This stock is there to take care of normal demand during the highest delay in normal lead time. In this case normal lead time is 4 weeks and it may prolong maximum upto 8 weeks. Again probability of such an occurence is 25%. Then safety stock is given by:

Safety stock = Highest possible delay in average lead time in weeks x Weekly average x Probability of such an occurence.

$$= (8 \text{ weeks} - 4 \text{ weeks}) \times 300 \text{ units} \times \frac{25}{100}$$

$$= 4 \times 300 \times \frac{1}{4} = 300 \text{ units.}$$

Reorder point (ROP) can then be arrived at by adding up the figures for buffer, reserve and safety stocks.

$$ROP = 1200 + 60 + 300$$
$$1650 \text{ units.}$$

Hence, as per the 'Q' system the organisation has to order 950 units (amount established by EOQ) when the physical stocks in hand + the expected quantity by way of unfulfilled orders drops down to ROP level i.e. 1650 units.

'P' system as applied to the above example.

Here we have to consider two points: i) fixing of review period, and ii) fixing maximum inventory level.

i) Review period fixing

As noted earlier, Review period in Weeks

$$= 52 \times \frac{EOQ}{A} \quad (A = \text{Annual demand}).$$

$$= 52 \times \frac{950}{15000} = 3.29 \text{ weeks.}$$

This figure can be approximated to 3 or 4 weeks depending upon the least total expenditure incurred. Now, when review period is of 4 weeks we have,

$$\text{ordering cost} = \frac{52}{4} \times 30 = \text{Rs. } 390.$$

(Note that $\frac{52}{4} = 13$ is the number of orders per annum.) and

$$\text{carrying cost} = \frac{15000}{13} \times \frac{1}{2} \times 4 \times 0.25$$

$$= \frac{15000}{26} = 576.92 \text{ say Rs. } 577.$$

Hence total cost for 4 weeks review period works out to Rs. 390 + Rs. 577 = Rs. 967.

On the same lines we can compute total cost for 3 weeks review period. Here we get, ordering cost =

$\frac{52}{3} \times 30$ = Rs. 520. (Note that $\frac{52}{3}$ signifies number of orders)

Annual carrying cost can be given by:

$$\frac{15000}{52/3} \times \frac{1}{2} \times 4 \times 0.25$$

(where $\frac{15000}{52/3}$ = average size of each order).

$$= \frac{15000}{52} \times 3 \times \frac{1}{2}$$

$$= \frac{45000}{104} = 432.69 \text{ say Rs. } 433.$$

Hence total cost for 3 weeks reserve period = 520 + 433 = Rs.953.

Hence 3 weeks review period which involves less expenditure is preferred.

ii) Determining maximum inventory level

It is made up of buffer, reserve and safety stocks.

Buffer stock

It caters to the normal consumption in normal lead time and the consumption during review period and is hence given by

$300 \times (4 + 3) = 300 \times 7 = 2100$ units.

Reserve stock

It takes care of fluctuations in requirements in lead-time and requirements in review period. The figure for it can be obtained by multiplying standard deviation by the square root of sum of the above mentioned two periods. It is hence given by

$30 \times \sqrt{4 + 3} = 79.37$ say 80 units.

Safety stock

Safety stock figure is the same as that in 'Q' system. (It is important to note that lead-time is different from review period.). Safety stock is concerned with the time factor. Since review period is fixed we have not to cater to the prolongation of review period.

Safety stock = Average demand in the maximum prolongation of lead time x probability of such an occurence = (8 weeks — 4 weeks) $\times 300 \times \frac{25}{100}$

$= 4 \times 300 \times \frac{1}{4}$

$= 300$ units

Then maximum inventory level which is summation of all the above three stocks is given by

$$2100 + 80 + 300 = 2480 \text{ units}$$

In 'P' system therefore stock should be reviewed every 3 weeks and the deficit should be ordered to build the total stock of 2480 units.

B.D. AMIN MEMORIAL LECTURE:

Cornerstones of Tomorrow's Chemical Industry: Innovation, Performance and Knowledge Engineering

Dr. R.A. MASHELKAR
Director
National Chemical Laboratory, Pune

I consider it to be a singular honour and a great privilege to have been invited to deliver the Rajmitra B.D. Amin Memorial Lecture of the Indian Chemical Manufacturers Association this year. Rajmitra Amin was among the doyens in Indian Chemical Industry. The spirit of innovation and entrepreneurship that he displayed throughout his life is the central theme that symbolises this lecture, and indeed it is this spirit that will enable us to face the challenges that I am going to refer to shortly.

The Indian Chemical Industry experienced a steady rate of growth for the first two decades after independence. In spite of the retardation of the growth due to factors such as oil price hike, increase in duties on naphtha, recession in demand for some of the products in later years, the industry showed resilience and bounced back. During the eighties large scale plants were built by taking advantage of Government's liberalised industrial policy of minimum economic capacity. By doing so, it expected to gain cost advantages.

It appears now that during the nineties, it will be faced with a circular problem of over capacity and consequent productivity slow down. This will lead to intense competition among producers. In order to survive, they will take a defensive orientation and emphasise cost as their main competitive strategy.

Cost advantage will depend on technology to a great extent. Majority of the R & D budget will then be spent on incremental changes in process or product innovation. Most importantly, a cost leader must achieve parity with his competitors in product quality or else his position in the business will be threatened.

One way to solve this problem is to differentiate. Differentiation dictates that a firm must seek to be unique in its industry on some parameters perceived to be important among its customers. Commodities are undifferentiated, while differentiated products with specialised characteristics or 'specialities' are designed to satisfy specific customer needs.

The directional change is thus from commodities to specialities now, indeed to speciality chemicals and materials that 'perform'. We will call this class as 'performance chemicals and materials' or simply, as PCM.

Performance Chemicals and Materials (PCM)

PCM can be defined in two different ways. The first is that these are entities which are produced in small volumes but fetch large unit prices. The other definition is that we can specially tailor these materials to perform certain tasks or functions. There are, therefore, special 'effects' or 'performances' that are produced by these materials.

A whole range of chemicals and materials can be classified as belonging to the PCM category with the broad definition that I have given above. They include many fine chemicals which find markets in the areas of paints, cosmetics, food processing, lubricants, electronics, textile and paper auxiliaries, initiators for polymerisation, additives to be used in fibres, plastics and elastomers, perfumes, flavours etc. Other low volume speciality materials such as engineering plastics, polymer alloys, structural adhesives, ceramics, catalysts are however, the prime candidates.

A key feature is the high risk involved in the usage of some of the high performance materials. Take the case of newly emerging high temperature adhesives which join metals, composites, ceramics and maintain the stability of the joint under conditions that are unimaginable with traditional adhesives. When they are used in aircraft, space vehicles, missiles or electronic parts, they will be required to resist environmental degradation and deformation under load for very extended periods of time. In microelectronics, the polymer will have to adhere to the substrate during various processing cycles with temperatures reaching 400° C in an inert environment.

Supersonic aircraft will demand several thousands hours of operation at temperatures upto 230° C. Missiles will require mechanical performance for less than a minute but temperatures during the flight can exceed 500°C to 600° C. The failure of these can lead to disastrous results and there is no greater example of this than what happened to US Shuttle Challenger, where the failure of a sealant was responsible for the eventual loss of several billion dollars, and affected the space programmes of US and other countries.

PCMs must perform and perform reliably and continuously, sometimes almost like the valve of a human heart! In fact synthetic human heart valve has been made and this itself is an example of a speciality product.

Key Characteristics of PCM Business:

Although we have clubbed them together, some characteristics, which distinguish performance chemicals and performance materials in terms of products, technology, markets, production, profitability and industry structure are shown in Table 1. The Performance chemicals business is reasonably stable when compared to performance materials business where the technology rapidly changes. Similarly, market growth for most performance chemical business is moderate against the high growth of performance materials. Further, in view of the embryonic nature of the performance materials business and the long development time needed, the margins and sales per employee for companies producing performance materials are lower than those making performance chemicals.

Let us clearly understand what differentiates a PCM business from its seemingly more mundane commodity counterpart. Most people believe that PCM businesses are attractive because they demonstrate price premia and non-plant barriers to entry. The price premium can be obtained if the speciality is able to reduce the cost of a process, improve the quality of the finished goods, have a large benefit-to-cost ratio i.e. if the cost of failure in the customer's end-use is high or if the cost of the PCM product is a small part of the customer's product. It may also arise if the customer has few technical alternatives or if the technology of PCM is distant from that of the customer's products.

The shift in business from commodities to PCM has been taking place gradually over the years in the chemical industry, but in recent years the rate has been accelerated enormously. Let me say a few words about the way this has happened abroad and why I feel this phenomenon is inevitable in India also.

The Present Scene Abroad and in India:

The winds of change from commodities to PCM have been blowing for some time now and firms in the United States, Europe and Japan have responded magnificently by making key strategic moves rather swiftly. PCM products account for major earnings (50-75%) of the chemical giants such as Du Pont, Dow, Monsanto, Union Carbide, Hercules, etc. The shift in strategy has been very skilfully done. For instance, a few years ago ICI formed a speciality chemicals group by inverting the traditional model. Most of ICI's business was organised into divisions, which were production oriented units with heavy asset bases, very heavy research and natural market areas. Today they are the other way around, most of their assets are in the form of skilled people, who value add by the quality of service they give to customers. This group was formed with the target of increasing ICI's speciality business from £150 million in 1983 to £500 million in 1990.

The key to this success of chemical giants has been obviously their recognition of the true cornerstones of this industry that I have reflected in the title — continued innovation towards sustained performance of the high-tech products and clever use of knowledge engineering. Aggression, vision and boldness are the key ingredients. They have to spend around 5% of sales just to stay in the market place. To be successful, they have to spend up to 10%. Their average life of a speciality product can be about seven years. That means they need to do enough research and development to replace 15% of their product line every year.

Today there is a rush by many business houses in India to get onto the petrochemical band wagon. One business magazine has rightly described this as 'The Great Petrochemical Gamble'. In nineties when all the projects go on stream, everyone will have to fight it out in the market place and it will not be possible for everyone to survive. The best thing to do in such a situation is to allow the natural market forces to operate, i.e. let the inefficient units close down. But this is not possible in a sociopolitical structure we have in the country. What are therefore the options before the chemical industry? Let us examine them.

The 'Kline Smile' Syndrome in Indian Chemical Business:

A typical commodity chemical producer has two strategy options in order to improve his profitability in the long-term. This is illustrated by the "Kline Smile", a term coined in recognition of Charles Kline, the consultant who first clearly defined these two options. We can see this 'Kline Smile' in Fig. 1.

The most profitable stages of operations in chemicals manufacturing are extractive products and chemical end-products, as indicated by the "Kline Smile". It can be seen that petrochemicals, including commodity plastics, occupy the trough position of the lowest profitability in the smile. Thus the strategic options for a commodity producer are two folds. One is 'smiling to the left'. This represents backward integration into raw materials. The other one is 'smiling to the right'. This represents forward integration into speciality chemicals.

Both options are beginning to be made in India now. Reliance, for instance 'smiled to the left' in building up a petrochemical base and it is further trying to get in to oil and gas business. IPCL on the other hand is trying to 'smile to the right'. Its purchase of the CATAD division from ACC to get into the catalyst business, its entry into cabling compounds, engineering plastics, etc. are strong indicators of this trend.

Backward integration for a commodity chemicals manufacturer in India is not always easy due to large resource requirements. Further, in India, the petroleum business is

Table 1
Key Characteristics of Performance Chemicals and Performance Materials Business

Characteristic	Performance chemicals	Performance materials
Products		
Nature	Speciality	Speciality
Cost per unit	Medium to high	Very high
Volume of sales	Low	Low
Difficluty of fabrication	Low to medium (a)	High
Convenience	High	Variable
Technology		
Level	High	High
Status	Moderately changing	Rapidly changing
Key disciplines	Chemical & end use	Multiple (b)
Major R & D funding	Company	Government & Company
Technical service	High to moderate	Very high
Markets		
Industries served by a product line	Few	Few
Market size	Small, niche	Small, niche
Market growth	Moderate to low	High
Principal consuming products	Nondurables	Durable goods
Marketing intensity	High	High
Government involvement	Low to moderate	High
Production		
Processes	Batch	Batch
Plant runs	Short	Short
Number of employees per unit of sales	Low	High
Profitability		
Current level	High	Moderate
Cyclicality	Moderate to low	High
Key source	Chemical formulation & synthesis	End-product fabrication, contract R & D
Industry structure		
Basis for competition	Performance & service	Performance & service
Concentration of suppliers	Moderate	Low
Links among suppliers	Few	Many

(a) For plastics, fibres, and other fabricable products.
(b) Chemical, ceramic, metallurgical and materials and equipment scientists plus physicists and mechanical, electrical/-electronic, and other engineers plus end-use disciplines (aerospace, automotive, agricultural, electronic, etc).

Source: Kline & Company

mainly concentrated in the hands of a relatively few major oil companies, which are either publicly owned (such as IOCL, HPCL, BPCL) or joint sector companies, which are being formed. We thus have a situation with very few degrees of freedom. Adding to this is the tendency of such companies to diversify downstream into chemicals; the recent forays of MRL, GAIL, etc. are obvious indicators.

Forward integration into value added end-products such as PCM is the obvious option left for many firms in India in the coming years. India has a chance to succeed in a big way in this endeavour. Why do I feel so optimistic about this? Let me explain.

Firstly, PCMs have low instance of raw materials cost in relation to the selling price. PCMs are essentially knowledge based and technology constitutes a part of the 'capital'. In fact, we already have a large number of well trained chemists, chemical engineers, technologists and this could mean the existence of a powerful force that will help us to have major entry and success in this business. Then there is the evidence of India's track record of having succeeded in a major way by developing novel routes for a variety of fine chemicals. This gives us a nice launching pad for an entry into the sophisticated market existing abroad. All that is needed is a will to take risks.

During the rest of the lecture, I will focus on the role of innovation, performance and knowledge engineering in the PCM business. My objective is not to identify individual business areas, which is a job of project planning and market research professionals. The objective is to alert you about the radical change in approach and attitudes that will be required to succeed. I do not want to be exhaustive, I merely want to illustrate the points with a few examples.

Performance Polymers:

Commodity polymers are sold in large volumes and in grades that are generally interchangeable. Performance polymers differ significantly from commodity polymers and they form an important part of the PCM business. Performance polymers are able to perform dependably over extended periods of time under demanding conditions such as high mechanical stress, elevated temperatures, corrosive environments, biologically demanding conditions, weathering, etc. When one buys a performance polymer, one is actually buying a 'property'.

Fig. 2 shows such a correlation between the price and the heat deflection temperature of a polymer, which is indicative of the level of thermal performance of the polymer. Let me briefly touch upon the commodity markets in plastics, fibres, etc. before I talk about the polymeric products belonging to the PCM class.

'Commodity Plus': The First Step Towards PCM

The use of commodity plastics such as polyethylene, polypropylene, etc. is increasing enormously. The demand has consistently out-stripped the supply so far. As a result the Government is considering approval of four major crackers with downstream units. Completion of these projects will lead to a great competition in this area. Quality & cost competiveness will then assume importance.

A transition from 'commodity' to the 'commodity plus' area would be a step in the right direction. Making 'commodity plus' plastics is a gradual differentiation from their commodity counterparts. In fact it is the first step towards PCM.

The property upgradation of commodities can lead to different application areas. Those pertinent to Indian conditions are industrial fabrics such as coated fabrics, filtration fabrics, civil engineering fabrics or geotextiles, performance textiles such as upholstery and insulation, barrier packaging, etc.

The key point to be remembered is that what is being sold is not a 'material' but a 'product' with a 'property', which gives 'performance'. There is a considerable scope for developing this 'commodity plus' sector by a judicious strategy. Invariably, a carefully designed compounding recipe and a processing strategy to meet a particular high performance application leads to a 'commodity plus' material. NCL's recent development of a material based on a thermoplastic for an application into two wheelers for Bajaj Autos is an example of a 'commodity plus' material.

Engineering Plastics:

Engineering plastics supersede 'commodity plus' plastics in the sense that the range in which they perform is far superior. Typical plastics falling in this category are polycarbonate, polyacetal, polyphenylene sulphide, etc. They replace metals in a cost effective way. Their light weights for the same volume combined with their exceptional properties makes them ideally suited for a variety of applications.

There is tremendous scope for engineering plastics in India due to the growth in the automobile, electronic and telecommunications sectors due to the enormous advantages such materials offer. There is virtually no R & D base on engineering plastics in the country today. Entry into this business is difficult because development is expensive and lead times are long. In an advanced country like Japan, a known engineering plastic such as polyphenylene oxide took eighteen years for introduction into the commercial market. It is therefore unlikely that rapid progress can be made in India on the basis of indigenous R & D alone. One will have to purchase technologies on a selective basis from abroad and absorb them as quickly as possible keeping at the same time an eye on

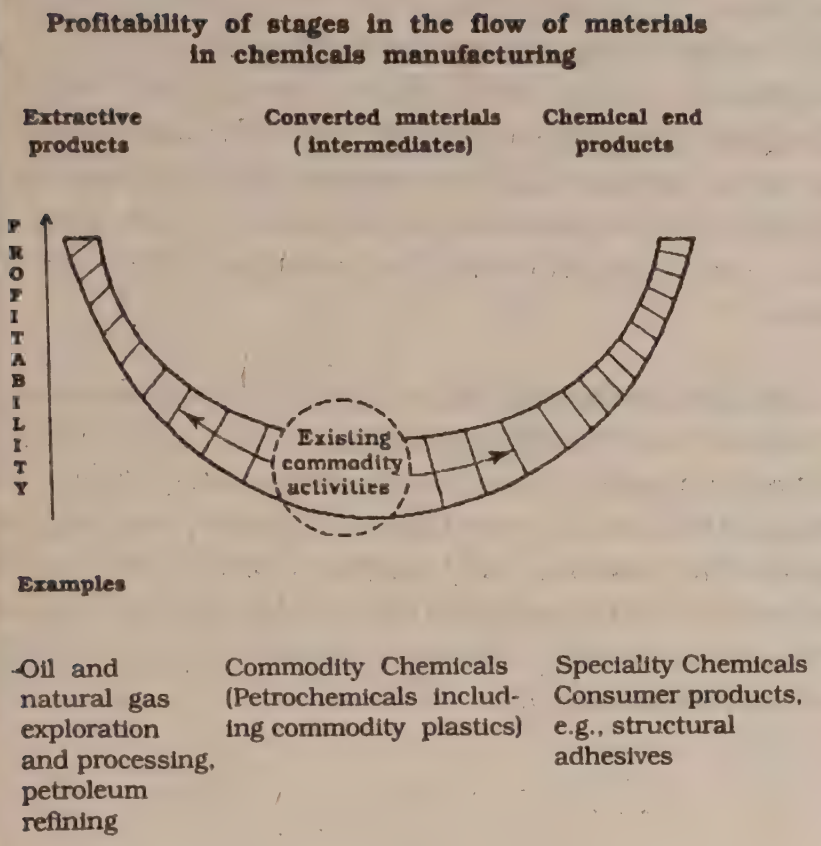


Fig. 1 Kline Smile

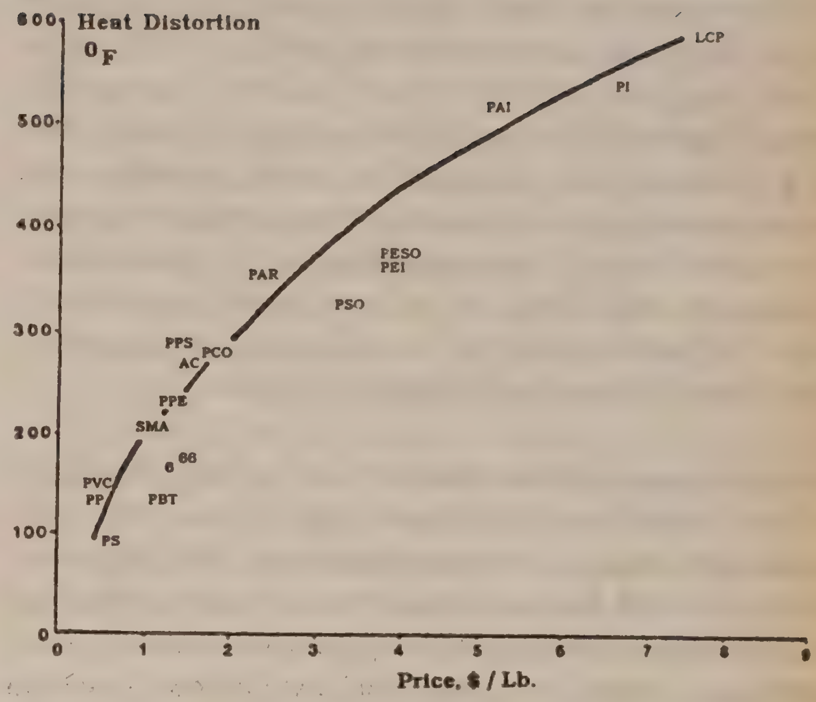


Fig. 2 The Price of High-temperature Performance

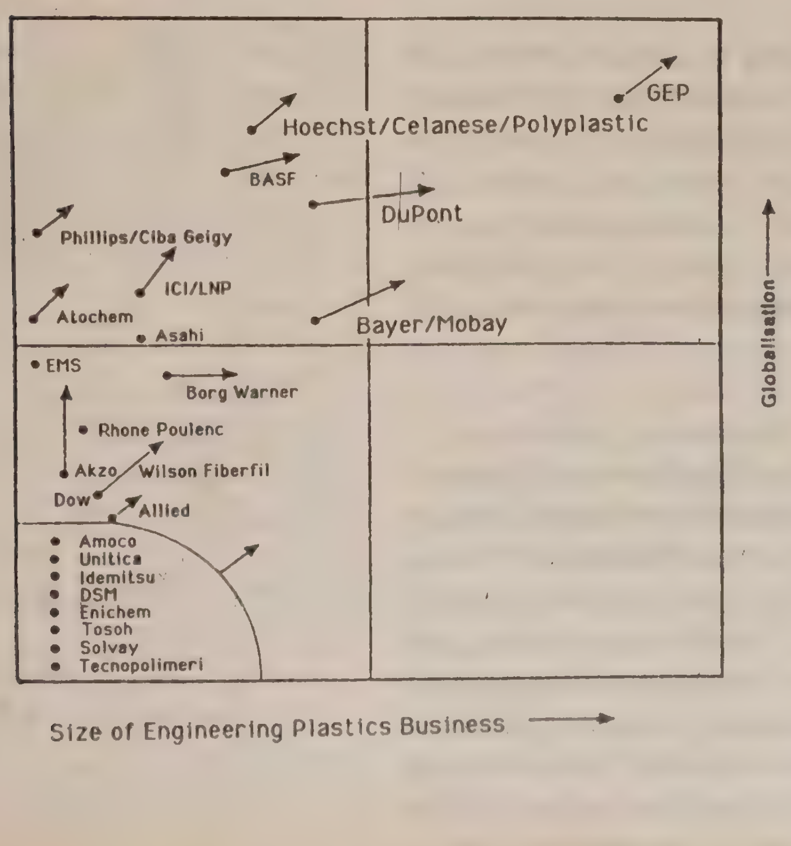


Fig. 3 Trends Towards Globalisation in Engineering Plastics

the applications that need to be developed to suit particular Indian needs. The question of availability of technology for engineering plastics from abroad therefore becomes a critical one.

The experience so far is that whenever an approach was made for importing technology on engineering plastics no one was willing to part with their technologies. This picture is changing gradually. IPCL's recent success in persuading General Electrics to join them in the engineering plastics venture is a classical case in point. One also hears about a collaboration coming up in polyacetal. These instances are a part of the recent trends on 'internationalisation' or 'globalisation'. As someone said 'Made in Britain' means assembled in Wales from parts moulded in Korea, using plastics specified in the United States and purchased in Japan!

It is important to understand the nuances and subtleties of this international trend from our point of view. The trend towards globalisation is demonstrated in Fig. 3. It shows how some of the well known companies have attained the goal of globalisation, either by forming joint ventures or just by expanding into another region. The length of the arrow is an indication as to how far is the company expected to go by 1995.

The supplier side is getting crowded. Growing number of suppliers is leading to fragmentation of the market and it is putting pressure on profit margins. In the United States alone there were 25 suppliers of engineering plastics in 1975. Now there are 70. The requirements of the end users are also becoming more sophisticated.

The engineering plastics industry in India is yet to take off. We recognise that conversion of the basic raw materials into useful engineering products has a long innovation chain comprising materials development (including reinforcing fibres, coupling agents, resins, etc.)., compounding process technology, composite processing, product development, applications development and value engineering, production engineering/tooling technology.

Rapid development of use of engineering plastics in the west is ascribed to the concurrent development in processing technology, applications development and product design coupled with production engineering capabilities. This has not simply happened in India. The constraints on the use of engineering plastics in India include the slow development in the areas of material development and processing machinery, non-availability of sophisticated processing machines (which could be micro-processor controlled and which will enable economic mass production of engineering kparts), lack of appropriate tool design and manufacture and resistance on product acceptance in conventional industries.

What happens once one enters the market? Successful substitution of existing materials by engineering plastic leads to a growth in this business. At the same time there is a loss of volume of business because of inter-plastic competition. No market is assured and safe and continued efforts are required to remain in the market. The efforts by Phillips Petroleum are worth emphasising here. After introducing PPS in the market as a coating and injection moulding grade material, they kept on innovating to introduce the film grade and fibre grade material to keep the leading position in the business.

Inter-plastic competition is a real motivator for innovation. One can meet the same specifications by using a range of different materials, which become progressively cheaper. The body of hand-held power drill, for instance, was originally made of die cast zinc, but it has been replaced by glass filled nylon-66, nylon-6 and glass filled polypropylene in a span of just 7 years. Fig. 4 shows the property range of selection of engineering plastics.

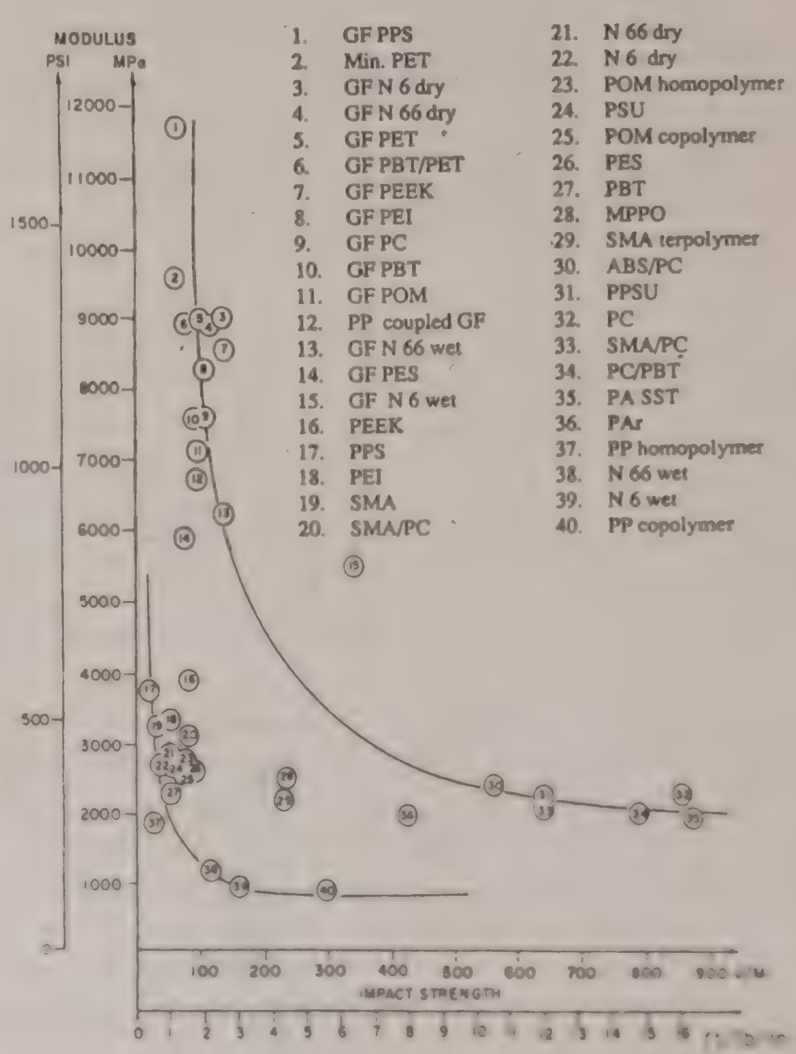


Fig. 4 Property range of selection of plastics

The crowding in certain areas means that the survivors will e only those who will continuously innovate and break away om this crowd as well as those who will have a strong and ffective marketing base. This intense drive for innovation reflected nowhere better than in what the Chairman of Sony orporation once said "Our job is to make our own products obsolete. If we do not do it ourselves, then our competitors will do it for us. That is our driving force. That is ur incentive". To me this is just about sums up the spirit hat drives the engineering plastics business today.

Polymer Alloys:

The technique of blending or alloying polymers could be effectively used to tailor-make materials in a cost effective manner for specific application needs. Thermoplastic blends represent the fastest growing segment because of the fact that alloying by physical blending allows product lines to be extended with new price/performance materials, without the added high capital expenditure associated with new polymer development and manufacture. Polyphenylene oxide-polystyrene blends are outstanding examples of blends in extrusion, injection moulding and structural foam moulding applications.

The potential for development of polymer alloys is virtually untapped in India, although a number of constituent polymers of potentially attractive alloys are already available. There is a great scope for developing and introducing ABS/PVC, PET/acrylic, ACS/PC, PVC/PMMA, HDPE/Nylon-6, HDPE/PPS alloys. The advantage is that there is a relatively short time between development and commercial production.

A good understanding of the property requirements for a given application is a must. The field is very crowded though. In past 15 years, there have been 70,000 patents filed in USA! The inter-material replacement, therefore, is very high. Since the polymer alloy business is at a nascent stage in India, a great growth is predicted for this business in the next decade.

Synthetic Fibres:

The commodity synthetic fibre industry, especially polyester fibre industry in India, is presently facing the problem of excess capacity and inadequate demand. Superior quality and niche markets through specialities will become critical for survival. The opportunities for innovation in the commodity synthetic fibre industry for developing 'commodity plus' fibres are enormous.

Consider, for instance, the type of synthetic fibres being developed in Japan which can change their dimensions and cross sectional shape under the influence of moisture. One obtains fibres which can both increase the moisture content as well as become water proof under the influence of moisture depending upon the level of humidity. The fibre consists of two components. One is hydrophilic, which swells under the influence of moisture and the other is hydrophobic. Manipulation of the location of the hydrophilic component and the shape of the cross section allows one to achieve this effect. The developments by Toyobo, Teijin and Nippon Easter are worth citing. Speciality polyester fibres with silk-like or wool-like appearance can be made now by new processing techniques. Knowledge-based innovations to produce commodity plus products such as these are going to give niches in the market, where overcapacities are creating problems for industry today.

High Molecular Weight Soluble Polymers:

A fundamental understanding of the behaviour of materials is essential before diverse applications can be conceived and developed. I will illustrate this point by speaking about a class of very high molecular weight (HMW) polymers (typically over one million) that are soluble in different solvents. The long chain structures impart very interesting characteristics, when they are dissolved in a solvent in concentrations ranging from few ppm to a few per cent by weight. Apart from behaving as viscous fluids, they demonstrate property of solid-like elasticity if suddenly stretched and deformed. How can these dramatic viscoelastic properties be used in developing polymers for specific applications? I will illustrate this with several examples.

One speciality polymer in the sector of oil field is the pour point depressants, essentially medium molecular weight polymers, commercially produced in India now. A different class is the drag reducers, which are high molecular weight polymers. Drag reducers can be added in very small concentrations (few ppm) to a flowing crude oil in a pipeline to achieve reduction in the pressure drop or enhancement.

The costs involved in building additional pipeline networks for increasing supply are very high and therefore drag reducers can be used to enhance the flow, whenever, there are demands for larger oil supply to refineries. Similarly demands for products such as kerosene, diesel, etc. are increasing and here too drag reducers can find potential application.

Companies such as Conoco, Arco, etc. are already in the business of supplying such drag reducers, and they have been used in the case of Alaska crude, North Sea oil, etc. However, these polymers, degrade because of their long chain character, when the flow occurs under turbulent conditions. This implies that the drag reduction effect goes down as you traverse the pipeline after the polymer is injected. The present drag reducers are, therefore, injected after the pump and a strategy of periodic injection is followed. This practice is cumbersome. So here is the major scientific challenge. Can we do molecular design of polymers that do not degrade under

flow? NCL has accepted this challenge by developing so called "self assembling polymers" wherein the broken polymer segments join together or 'reassemble' on removal of shear. The concept is successful in the laboratory, but we have some way to go before commercial exploitation. These polymers can also be used as anti-misting additives for aviation fuels. During air craft crashes the major damage is caused by the bursting of the fuel tank and continuous atomisation of the fuel. If this atomisation can be prevented just before the crash, then there is a good chance that there will be a survival. HMW polymer solution, when deformed rapidly in the atomisation process, behaves like elastic solids, refuses to atomize and we have long strings of the fuel rather than a fine mist which readily explodes. The same polymer thus has a radically different market.

Take the question of oil spills. We know about the recent problem of the big oil spill approaching the Indian coasts. The HMW polymers can be used for removing the oil spill with ease and speed. The property used in developing this application is again the viscoelastic characteristics. The solutions of HMW polymers demonstrate what is called as an inverse siphon effect. One can pull the fluid through a vertical tkube, like a rope, in such cases. In an actual application what one has to do is sprinkle such HMW polymers on the spill and let it dissolve. The spill acquires an elastic character and can be pulled like a rope. The improved stability due to the elastic character means that oil spreading, streaming, breaking up due to wind and wave conditions is reduced. If the spill reaches the sandy beaches then the penetration depth reduces too. The scientific challenges are now different. Degradation of the polymer is not so critical any more. We must make the polymer dissolve very quickly, a very difficult task, because polymers are notoriously slow in dissolving. This problem can be solved by a proper formulation. NCL has again accepted this challenge and we have a formulation that dissolves quickly. The use of such techniques has many of other possibilities. To meet the stringent environmental control regulations such techniques can be used for getting rid of minor and major spills of dangerous organic materials in factories and elsewhere also. The job is now that of the application engineer and the marketing man!

The above illustrations are given essentially to show as to how the same polymer can be formulated and marketed for diverse applications. One hears of over 100 grades of PPO/PS resin or over 30 grades of polyacrylamide flocculent tailor made to meet a special demand. Each application means a technical challenge. This can be met with a scientific approach and a dedicated team effort. This is after all the crux of the whole PCM business.

Other Speciality Polymers:

I want to alert you that there are other specialised markets that are growing in the west and these are bound to have a impact in India sooner or later. They include polymers fo information technology (electro and photo conductive pol ymers, polymers in fibre optics etc), polymers for biosystem (biopolymers, polymers in bioseparations, polymers used a carriers of drugs and for immobilising enzymes), polymer for separation technology (membranes, enhanced oil recov ery), polymers as lubricant additives, superabsorbing polym ers, etc.

A strong interdisciplinary effort is required to enter and stay in such markets. Some of these products are highly knowledge based and command a very high premium. Polymers in the dental and opthalmic areas have such attractive markets. For want of space and time, I will not dwell on them now but anyone interested in the PCM business in polymers should certainly watch out for developments in these areas.

High Performance Ceramics:

We are familiar with traditional ceramic products used in building materials, refractory bricks, household crockery, etc. Today's industrial ceramics are value-added materials which demonstrate superior electrical, magnetic, optical and mechanical properties and performance. These products are based on commonly available raw materials such as the oxides, nitrides or carbides of silicon, aluminium, zirçonium and iron. The hallmark of this sector of business is that commodity materials are converted into high value added components by sophisticated high technology processing and manufacturing systems.

Continuous demand from various end-use sectors for high performance has led to stringent specifications for raw materials and changes in processing systems. Consider the case of zircon which has been considered as a byproduct or coproduct of the titanium minerals ilmenite and rutile.

This zircon sand was traditionally used for bulk products such as refractories after some physical processing. But today high performance applications such as multilayer electronic capacitors fabricated with metal zirconate and metal zirconate titanate compounds require a raw material which has low impurities and uniformity of particle size. The same is the case with ferrites. The existence of magnetite, a typical ferromagnetic ferrite, has been known for more than 2000 years now. However, practical utilisation of the ferrites began during the last half a century. Ferrites have been mainly used as magnetic materials for inductors and transformers in electrical circuits. The main task has been to increase permeability and reduce magnetic loss. This has led to the development of a range of ferrites containing different metals and rare earth materials with a variety of applications ranging from permanent magnets to substrates for bubble memories.

High performance ceramics, both electronics and structural, are growing rapidly. Electronics applications account for approximately two thirds of the total market value of world production of high-tech ceramics. Structural ceramics are used in many engineering applications such as wear parts, tools and dies, pump and valve components, engine components, etc.

High-tech ceramic industry consists of four primary levels of participation: powder manufacturer, functional product manufacturer, system fabricator and original equipment manufacturer. The powder manufacturer produces fine and pure particles of oxides, carbides, nitrides, etc. The functional product manufacturer forms powders into desired shapes, he densifies and fires them at high temperatures, following it by finishing or machining. It is sometimes necessary to add other materials to ceramic shape to make the functional product. The system fabricator assembles the functional product into a larger workable system. The end user consumes or assembles the functional product or the fabricated system into a downstream product.

Traditionally ceramic products have been made from a slurry or paste of a finely ground mineral. The slurry is formed or cast in the desired shape and then 'fired'. Today a number of new chemical techniques are being employed to synthesize ceramic precursors and produce final products which are free of impurities and defects. These techniques depend upon the control of reaction kinetics and tailoring of molecular properties. Thus, controlled hydrolysis of organometallic compounds is used to generate highly uniform ceramic particles. This is knownas sol-gel technology.

Organometallic polymers can be spun into fibres and pyrolyzed to produce important materials like silicon carbide. The other new techniques being used are: mechanical processing, chemical vapour deposition, dry and wet pressing, type casting, plastic compaction, slip casting, cold isostatic pressing, hot pressing, sintering and reaction bonding.

As explained earlier, the electronics applications dominate the high-tech ceramic applications. The other markets have not grown due to physical property limitation i.e. they tend to be brittle and they are difficult to shape after sintering. To overcome these problems, research in U.S. and Japan is directed towards feedstock and property improvement and brittle material design and engineering.

The emergence of ceramics as high performance materials provides great opportunities to chemical and metallurgical firms in India to diversify in two years. One is to process the mineral raw materials into high purity powders for export and secondly to convert powders into finished products which are being imported today.

Catalysts as high performance materials

The catalyst manufacturing industry has all the characteristics of a speciality business. Products are sold on performance; there is a close interaction with the customers and a high level of technical service is provided. There are only two important differences. One is the conservative attitude of customers. Petroleum refiners and petrochemical producers are reluctant to switch over from a well known catalyst to an untried system, where a large risk is involved. Secondly, the profitability in this business may not be very high. This is due to over capacity and increasing raw material prices. In fact catalyst industry is a classic example of 'globalisation', to which I made a reference to in connection with engineering plastics.

Everyone in the business is struggling to maintain margins and they are forced to tailor the products to individual customer's needs. In order to survive they are developing a portfolio of products, each of which is unique and performs exactly in the way the customer wants it. For example, Air Products has about 400 different polyurethane catalysts in the polyurethane industry, but also works with the surfactants and other processing chemicals used by customers. An essential requirement of this market now is that the customers demand that the supplier must bring the whole additive package. This forced Air Products to acquire Dow Corning's silicone surfactant business.

The threat of ban on the use of CFCs as blowing agent in near future will mean that a catalyst manufacturer must think of new foam manufacturing methods, different catalysts and surfactants. Similarly, whenever petrochemicals prices come down, producers want higher selectivity catalysts, which consume less energy. These kinds of demands on customizing and improving efficiencies is forcing the catalyst manufacturers to spend large part of their R & D budget on solving customer's problems at the cost of development of new products. Today 40 to 80% of business of every catalyst manufacturer is in custom catalysts.

Any future market opportunity will lie in very small-volume speciality systems, which can be used for the production of high value fine chemicals and pharamceuticals. Zeolites for fine organic synthesis will fall in this category. We at NCL are building up a school in this area. It is also predicted that less-hazardous solid acid catalysts will be substituting hydrofluoric and sulphuric acids used in the chemical and petrochemical industries. Catalytica, a catalysis development research firm is working on the development of 'MELS' (molecularly engineered layered structures) for this application. MELS consist of sandwitches of inorganic and organic layers in which the acidity can be manipulated around a catalytic site by changing the composition of layers.

Researchers in the catalysis field are also reinvestigating pillared clays, because successful application of zeolites in many processes suggest a bright future for shape-selective catalysts generally. One possibility is in polymerisation. It is felt that cavities between layers may produce uniform molecular weight distribution and the cavities may be large enough to allow polymer molecules to exit after formation. Pillared clays may be useful for catalysing reactions of many large molecules. Steroids and antibiotics are of such a molecular size that they may fit into the interstices of pillared clays but not those of zeolites.

The size of the Indian catalyst industry is very small. The three major units put together do a business of about Rs. 20 crores in a year. Most of the catalysts are mainly imported from process licensors or their associated catalyst manufacturers. Until now, excluding some notable exceptions, most of the indigenous effort has been to replace the imported catalysts. It is heartening to note that today catalysts manufactured on the basis of our own technology are being exported from India. I therefore wish to point out that very often whenever question of indigenous manufacturer of speciality materials is raised, the proposal are turned down in the board rooms, just because the size of the Indian market is small.

Today the whole world has become a single market not withstanding artificial tariff and other barriers put by different countries. We must look at the global market and plan our business accordingly. This is what we have decided to do in the case of market for our research and development. If Indian industry will not be ready to accept indigenous developments in such high-tech areas, then laboratories such as ours will be forced to move out. In a sense, this will be a 'forced globalisation'. The concept of globalisation is not only, applicable to industrial production but also to industrial 'R & D'.

We have realised from our own experience in catalyst R & D in NCL that in order to be successful in this area, the key factors are manufacturing and/or marketing base in major markets of the world, extensive R & D facilities, comprehensive technical service, excellent track record, comprehensive portfolio of products and pilot plant facilities and process design capabilities.

There is a fair amount of R & D effort in India in applied catalysis now. About half a dozen institutions have major programmes in this field. At NCL, it is one of our thrust areas. Our investment in catalyst R & D has been to the tune of a few crores now. Our recent success in marketing the innovative *Encilite* series of catalysts have emboldened us to build more ambitious programmes in this area, with the dream of not merely being 'competent' but 'competitive' in the world market.

Performance chemicals

Until now the emphasis was on performance materials. Let us now have a brief look at performance chemicals. There are about 50 categories of performance chemicals, some of which have been listed in Table 2. These chemicals can be divided into three types.

1. Synthesis of a chemical compound or proprietary active ingredient. Surfactants, enzymes are examples of this.
2. Formulation of a product for use by the customer. Flavours and fragrances, adhesives and sealants are examples of this class.
3. Delivery of the product at the point of use, backed up with a high level of technical service. Oilfield chemicals, metal plating chemicals, paper additives are examples of this.

According to me the people who are in the fine chemicals business are well suited to take a stepping stone in performance chemicals business. They have some background of working with small volume products and they normally adopt one of the following two approaches for product development: single raw material base and different technologies or single technology base and different raw materials.

In order to move into speciality sector, one will have to find out certain segments which may be amenable to development by the skills of a fine chemical producer. There are two main types of specialities: functional and market. The former are products such as antioxidants, which have applications in wide number of industries. The other type consists of a group of products, which cater to one particular industry, for example, construction chemicals.

With few exceptions, the products sold on a functional basis to a number of industries are generally specific chemicals, whereas the second category consists of formulated products. It is the functional products which can be taken up by the traditional fine chemical producers since they have the research and synthesis skills in molecular manipulation, i.e. in designing an actual molecule to have a specific function. In the second case, one will have to build an expertise in an industry and then formulate products to meet the needs which are identified.

No matter which approach is followed, the key secret is to get into the market first, take the highest reasonable profit and then hang on as competitors try to dislodge you with better products or lower prices. Even in that situation, it will be better to be proactive rather than reactive. It is better to displace your own product by innovation as I said earlier.

It is this sector of PCM business which has already attracted the attention of Indian chemical industry. Few companies entered the market in sixties and seventies by supplying textile auxiliaries and during eighties they moved into

Table 2*
Major Performance Chemicals

Category	Apparent Profitability	Ease of Entry	
		Technical	Commercial
Adhesives and sealants	High	Hard	Hard
Construction chemicals	High	Medium	Hard
Cosmetic additives	Average	Medium	Hard
Diagnostic aids	High	Medium	Medium
Elastomers	High	Hard	Hard
Electronic chemicals	High	Hard	Hard
Enzymes (industrial)	Average	Medium	Hard
Flavours and fragrances	High	Medium	Hard
Food additives	Average	Medium	Hard
Fuel additives	High	Medium	Medium
Dyes (functional)	High	Medium	Medium
Foundry chemicals	Low	Medium	Medium
Industrial cleaning products	High	Easy	Medium
Lube additives	High	Medium	Hard
Metal plating and finishing chemicals	High	Medium	Medium
Mining chemcials	Average	Medium	Medium
Oil field chemicals	High	Medium	Medium
Paint additives	Average	Easy	Medium
Paper additives	Average	Medium	Medium
Photographic chemicals	High	Hard	Hard
Polymer additives	Average	Easy	Medium
Rubber chemicals	Average	Medium	Hard
Surfactants	Average	Easy	Easy
Textile auxiliaries	Average	Easy	Easy
Water management chemicals	High	Easy	Hard

* Largely based on Charles H. Kline & Co.

oil field chemicals, but most of them have remained content by just supplying the chemcials and downstream integration into service or systems has not taken place. I may add that the greatest added value and highest profits are in moving downstream. Just do not remain content with being speciality material supplier, integrate your products in a system or fabricate an end product. This is what companies abroad are doing. For example in the field of electronic chemicals companies like Ciba-Geigy do not just sell the resist, but a package of know-how and machinery covering the complete process from precleaning to coating, drying and exposure. They feel that it is the only way to guarantee the quality of end-product. The speciality products of tomorrow will be sold as systems or with a service.

I find there are many business houses, who are eyeing this market and quite a few foreign collaborations also have been signed. There is a word of caution for the new entrants though. Most industrialists begin with a set of business entry criteria defining growth, margins, profit requirements and so on. What is required is a full understanding of the nature of the service which is essential to determine the extent of business defensibility and long-term profitability. A performance chemical manufacturer has to offer pre-sales and post-sales services.

The first pre-sales prerequisite is in terms of R & D. Basic research to discover new "effects" which have demonstrable value to the client base are essential. Customer-specific problem solving is a key skill required. Then there is the question of applications development. Problem solving and tailoring a product to the customer's end use requirements becomes important. Selling is the third pre-sale prerequisite. Enhancing the technical conviction of the client is essential.

As far as post-sales services are concerned, distribution, support and back-up are important. Distribution involves an enabling retail and/or wholesale distribution function, depend-

ing on whether the market is diffused or concentrated. The support function involves a continuous involvement as an essential element of the product offering — that means continuous monitoring of results. The backup services may involve emergency technical trouble shooting, if possible, in the exceptional cases only. Every speciality business has a different mix of service attributes which help explain and justify different profitabilities of speciality segments.

Launching a new speciality business can be difficult. In specialities, the payoff is less certain and personnel costs are high. Few companies are willing to invest in specialist manpower. Secondly cash-flow generation becomes more dependent on large net profit margins being realised and sustained, and less dependent on the depreciation, as is the case with commodity chemicals. In other words commodity company pays for equipment and speciality firms pay for innovation and people.

I want to alert you that the speciality sector is highly people-intensive, and market-and-service-oriented. It is not a business for every major commodity manufacturer. Companies with wrong 'corporate' culture are bound to fail. An organisational system that is rigid and hierarchial will not do, since the slow decision-making process will kill the speciality business. Speed of response is the most important factor in the speciality market. If you enter this business, then as a top manager, you will not be making investment decisions but seeking out market opportunities and moving in quickly to plug the gaps.

To survive in the speciality business you will have to sell the product with a high level of technical assistance. You will require people, who approach their jobs as problem-solvers and consultants rather than as mere salesman. You have to make sure that these are capable of penetrating an organisation from the purchasing department to R & D to the production line.

You will have to develop certain in house strengths. You will require highly trained and experienced staff for research, development, technical sales/service and last, but not the least, for marketing and sales. You will have to meet the R & D, technical service and direct selling costs from very large and virtually inexhaustible budgets so that you can run the business effectively and successfully.

Biotechnology

So far I have talked about PCM, where the emphasis was on innovation and performance. Another emerging industry which all of us should watch with excitement and anticipation is biotechnology, which again is knowledge intensive and has many features common with PCM business. I will briefly touch upon some aspects of this industry.

Biotechnology has been regarded by many as 'the last major technical revolution of this century'. Biotechnology, broadly defined, includes any technique that uses living organisms (or parts of organisms) to make or modify products, to improve plants or animals, or to develop microorganisms for specific uses. Breakthroughs in our understanding of the structural and functional relationship between the molecules and macromolecules within the biological systems have enabled us to manipulate their chemcial structure, both within and outside of living organisms. This ability to select and manipulate genetic material has sparked unprecedented interest in the industrial uses of living organisms. Scientific researchers have begun to recognise the potential for directing the cellular machinery to develop new and improved products and processes in a wide variety of industrial sectors.

The new techniques which enable us to have a control over biological systems are extremely powerful. I will just mention application of two of these techniques i.e. recombinant DNA technology and cell fusion.

Recombinant DNA technology consists of ways to purify and identify genetic material (DNA) from one source, tailor it for insertion into a new host organism, and isolate a colony of cells containing the desired genes. These genes are then directed to synthesise a desired protein. For example, insulin (a hormone) is a protein used for the treatment of diabetes. The gene that led to the production of human insulin was synthesised by chemists in 1978 and was engineered into a plasmid, which was introduced into the common bacterium, E. coli. A similar example is the development of human growth hormone. Genetic modification of classical vaccines to get safer and better products is another application.

This technology can also be used to develop organisms that themselves are useful, such as microorganisms that degrade toxic wastes or new strains of agriculturally important plants. These examples illustrate the great power of recombinant DNA technology to synthesise, on a potentially large scale, valuable protein materials that would be difficult or prohibitively expensive to produce by other means.

Cell fusion, the artificial joining of cells, combines the desirable characteristics of different types of cells into one cell. This technique has been used recently to incorporate in one cell the traits of immortality and rapid proliferation from certain cancer cells and the ability to produce useful antibodies from specialised cells of the immune system. The cell line resulting from such a fusion, known as hybridoma, produces large quantities of monoclonal antibodies (MAbs), so called because they are produced by the progeny, or clones, of a single hybridoma cell. MAbs can potentially be used for many purposes, including the diagnosis and treatment of disease and the purification of proteins.

The commercial success of specific industrial applications recombinant DNA and cell fusion techniques will hinge 1 advances in bioprocess engineering. In the next decade, mpetitive advantage in areas related to biotechnology may epend as much on developments in bioprocess engineering s on innovations in genetics, immunology, and other areas f basic science.

Biotechnology could potentially affect any current indurial biological process or any process in which a biological atalyst could replace a chemical one. Industrial applications f biotechnology will be found in several sectors, including harmaceuticals, agriculture, speciality chemicals and food dditives, environmental areas and commodity chemicals. The otential applications of biotechnology are probably more aried for speciality chemicals than for any other industrial ector at the present time. About 20 per cent of the U.S. companies using biotechnology are reported to be working in the speciality chemical field. Generally, complex products, such as enzymes are thought to be made economically by using bioprocesses. But the speciality products which are becoming commercial are polysaccharide biopolymers such as xanthan, pullulan, polyhydroxybutyrate, emulsan and biosurfactants.

If the speciality chemical industry is to take full advantage of biotechnology, then sharing of information between industrial chemists and biologists becomes essential. I must mention here that development of biotechnology is based on strong multidisciplinary interactions. For example, recombinant DNA technology is a recent discipline whose roots reside in the fusion of nucleic acid chemistry, protein chemistry, microbiology, genetics, and biochemistry. Further developments in the field will depend on developments in all of its parent disciplines. This is a prime example of knowledge engineering, which is not only restricted to research phase. There has to be a group of applied scientists and engineers for scaling up and operating the facilities incorporating modern biotechnological advances.

The science and research intensive nature of biotechnology business is seen by the fact that the biotechnology revolution abroad was born in the laboratories of the universities rather than in industry. Leading biological scientists have turned away from pure science to the lucrative world of business. The distinction between the completion of research project and the creation of a potentially commercial product are becoming blurred. For the first time in biology since the early days of antibiotics fermentation, industry and academia share common goals and are cooperating to achieve them. They have realised that proper biotechnology cannot be done in isolation, and they must join hands.

The ability to encash on new biotechnologies will depend to a great extent on the company's knowledge base and on making the right decisions at the right time. The over-optimism of many connected in the field in the past decade has now been replaced by a necessary caution. However, there is no denying the fact that vast potential exists for biotechnology, the question is how to exploit this potential. The best way is to focus primarily on areas related to your company's existing business. If one is in agrochemicals and fertiliser line, look at biopesticides, biofertilisers, plant genetics, etc. If one is in drugs and pharmaceuticals concentrate on diagnostics, recombinant DNA based drugs, etc. If one is in speciality chemical manufacture, look for products like polysaccharide biopolymers which will have applications in oil fields for EOR, food products, etc.

Another point I would like to emphasise is that a lot of fundamental research still has to be done in some of the areas mentioned earlier, such as plant genetics. Hence any research in this area must tend to be of the 'window on science' variety — i.e. going for knowledge rather than a specific commercial objective. This is best accomplished by having research contracts with universities and research laboratories, because the fundamental knowledge you want is still in these organisations.

It is not only that the manufacturers of chemicals who have to take notice of biotechnology. Even engineering consultants who appear to be sitting prettily with the oncoming boom in the petrochemicals field will have to do so, if they have to look beyond nineties. The main obstacles in biotechnology becoming commercial still lie with the problems of scaling up. World over all engineering consultants are gearing up to get in on the biotechnology act when it finally takes the centre stage. They have signed collaborative agreements with genetic engineering companies for jointly developing biologically-based processes. Even equipment manufacturers like Chemap, run a microbiology laboratory where applied research is undertaken in order to improve its fermentation equipment. In-house R & D is also carried out in the field of automation, including software.

Many large corporations abroad have entered biotechnology business by merger or acquisition of smaller specialist biotechnology companies. Even in acquisition it is not the balance sheet, but the research portfolio which determines company's potential.

Knowledge engineering

Classically knowledge engineering is understood to be intensively linked with computers, be they thinking computers as in artificial intelligence, or be they machines used for rapid information retrieval, analysis, etc. To my mind, knowledge engineering signifies something far broader, which has the ability to synthesise a vast array of advanced knowledge

from various disciplines towards a target. These targets could be as diverse as finding an optimal manufacturing strategy by organic synthesis and/or biotransformation, designing a new material or fault diagnosis in a chemical plan. I have already touched upon the aspects of the role of human intelligence but computers are playing an increasing role in all such endeavours now. I will mainly focus on two aspects, namely the use of computer-aided synthesis and knowledge-based expert systems.

The primary purpose of computer-aided synthesis is to achieve speed and avoid wasteful expenditure in terms of time and money. The computer is a useful aid in organising, recalling and retrieving chemical information and in generating potentially viable synthesis routes. An organic chemist can thus first synthesise on the computer before starting the final experimentation, rather than adopting the usual trial and error methods which are time consuming. After all for a fairly complex multistep synthesis, the number of experiments are inexhaustible. The classical example is vitamin B_{12} whose preparation involved the efforts of several superb chemists over a span of 10 years. Quantitative Structure Activity Relationships (QSAR), which use statistics, artificial intelligence, graphical, topological and other methods are particularly powerful. QSAR can even be sued to quantify subjective responses as in the study of human reactions to flavours and scents and has been already applied to the study of artificial sweeteners.

The chemical industry around the world is using these advanced techniques. Du Pont is using advanced molecular modelling programmes for research in textile fibres, crop protection chemicals, pharmaceuticals, paints, and plastics. There are more than 250 computers exclusively used for such research programmes. ICI has been using it to narrow possibilities in searching for mining chemicals to extract copper ions from other metal ions. Proctor & Gamble has done extensive work on molecular modelling of sweeteners and soaps and it has produced new product ideas which would have been difficult to find otherwise. Eastman Kodak has developed improved photographic chemicals through the computer-aided molecular design.

I have earlier talked about the need to design new materials. It is becoming increasingly possible to model the property of a polymer accurately by using interactive computer graphics. There may be some scepticism among some of you about the real use of such tools in practical cases. Let me reassure you by citing something that I read while preparing this lecture in the late August issue of Japan Chemical Week. Biosym Technologies Inc. has just started a project aimed at pioneering software capable of facilitating polymer design. This software will be developed by integrating data bases and software already established and combining atomistic/mechanical/statistical methods. QSPR, rotational isomeric stat theory and lattice techniques will be employed for this purpose. Not only the effort is new and novel but also the management of this whole system is novel too. The project is actually being tackled by 12 scientists and programmers at Biosym. They will work with a Scientific Advisory Committee comprising leading polymer scientists from Japan, USA and Europe. The member companies will be able to monitor and guide their work through a steering committee to ensure that the results and priorities are fully responsive to member companies needs. We in Indian industry have not even begun to understand the potential of these tools. We must take quick action to make sure that this great development and revolution does not pass us and we remain helpless spectators.

Recent advances in Artificial Intelligence (AI) and the emergence of Knowledge Based Systems (KBS) or expert systems are poised to make significant contributions to these goals of hastening the pace of R & D as well as the operations in the PCM sector. A number of systems have been developed and used in the chemical industry in the developed world today. They range from trouble shooting in a fluidised catalytic cracking units to the selection of a high performance material for a given application to the design of a complex polymeric product. Unfortunately there is not a single school in the country dealing with the development of such systems and efforts in this direction will have to be started practically immediately.

Commitment, investment and strategy in R & D

PCM business depends upon innovation, performance and knowledge engineering and this means a high level of commitment and investment in R & D. It is interesting to see the trends in the United States. Figure 5 shows the published figures for R & D expenditure for a number of chemical companies in the United States. As one moves from the commodity area to the speciality area the sharp increase in the R & D expenditure as proportion of sales is evident. It is to be emphasised that the horizontal axis is somewhat subjective because one man's speciality could be another man's commodity.

How can we in India respond then to such a situation. Can we be as bold as the big players in the world? We have often lamented about the level of R & D investment in the country, but occasionally one finds some bright spots, which triggers our hopes on. I was impressed by what Dr. Gharda said when he presented a paper at the national conference on chemical exports organised by ICMA in New Delhi earlier this year. I quote from his speech on 'Speciality Chemicals and Custom Synthesis'. "The business is lucrative but not meant for conservative people with weak nerves as there is rapid obsolescence which necessarily implies a high R & D

ntent in the total company's operations and the capability frequent adjustments to rapidly changing demands. Obvisly in this field, know-how is rarely available from outle except with equity participation, and in-house gineering ability is a great asset for rapid changeers and modifications. Our company employs more than e-fourth of the total number of our employees namely about 50 in our R & D centre and spends regularly about 8% of ır turnover on this activity. It is thrilling and exciting and e in our company love it."

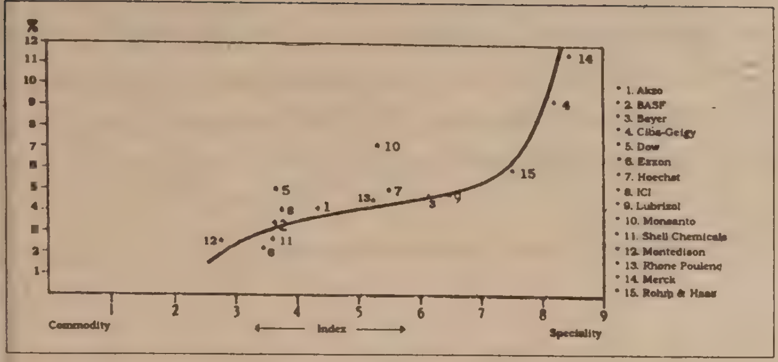


Fig. 5: R & D Expenditure as Proportion of Sales in Speciality Business

Such will be the level of commitment and investment in R & D that would be needed in order to succeed in the PCM business. Risk financing will play a very major role considering the high cost of R & D in this business that I have referred to earlier. Venture capital organisations like TDICI, RCTFC can play a key role, if they support 'new innovations' rather than 'new entrepreneurs' as is the case presently. It is heartening to hear that TDICI is even thinking of supporting industries in sponsoring research at university and laboratories to the extent of 50%. Such and other aggressive initiatives will certainly help the growth of PCM industry.

I have cited examples of trans-national cooperation in high performance polymers earlier. The idea of cooperative research centres must be promoted. A case in point is that of the high performance composite centre of University of Delaware. 20 companies from US, Japan and Europe support this centre financially. The generic knowledge developed is shared by these companies and they develop specific products on the basis of this knowledge. Since PCM business is very knowledge intensive and expensive in terms of the R & D cost, should not such innovative efforts be made in the country? This will require very drastic change in the attitude of our industry where false ideas about secrecy and propriety are coming in the way of progress.

Technology development challenges in PCM

There are some unusual challenges for chemists and chemical engineers, which are posed by the new demands of the PCM business. I will like to mention some of the special requirements of professionals and the kind of challenges that the manufacturer of performance chemicals is likely to face.

The scale of production of speciality chemicals is generally low. It is thus common to find batch processes and one must have the ability to design flexible manufacturing plants so that varying market demands can be met. The cost of raw materials, in some cases, may be high. In spite of the lower scale of operation, the problems associated with corrosion, health and safety, effluent disposal, etc. may be severe.

Achieving high levels of conversion and selectivity are quite crucial in speciality chemical manufacture, since many reactions are multi-step ones. Many innovative techniques will have to be thought of for conducting reactions. Prof. Sharma in his ISCRE-10 plenary lecture in Basle last year considered some such innovative strategies. The specific advantages of using novel strategies by imposing a second liquid phase, phase transfer catalysts, aprotic solvents, biochemical transformations, etc. have been highlighted. A clever manipulation of the reaction environment at both microscopic and macroscopic level by the use of micelles, microemulsions, hydrotopes, zeolites, molecular engineered layered structures, cyclodextrins, etc. have been also highlighted. It is not my purpose to give details of such innovative techniques here, but to emphasise that innovations of all sorts will have to be adopted in order to make PCMs.

The fact that the scale of production is small will offer real challenges in many different ways. The control strategies for batch reactors have not been well developed. The specifications of some of the materials may be such that the impurity levels are specified at ppm or ppb levels. This implies unusual challenges in separation science and engineering. The unstable nature of products at high temperatures as well as closeness of boiling points of the constituents of the reaction can be crucial too. We may have interesting situations, where the choice of the process route to be followed may be dictated more by the problems likely to be encountered by separations than anything else.

The production of new biotechnological specialities requires emphasis not only on novel bioreactor design but also on innovation in downstream processing. Many laboratory techniques such as chromatography, gel permeation electrophoresis, affinity chromatography, etc. will have to be enlarged from laboratory to preparative to production scale.

The culture called innovation, performance and knowledge engineering

New professionals including chemists, chemical engineers and technologists will be dealing with industries, whose products are quickly displaced in the market place by new strategic products, which are vastly improved ones. These professionals have served industries competing on the basis of price and availability so far but will now have to serve industries that compete on the basis of quality and product performance.

Chemical engineers today are taught in such a way that they build expertise in process design, but now the expertise will have to be in designing products with special performance characteristics. Expertise in designing industrial plants dedicated to a single product or process will have to be converted into expertise in designing flexible manufacturing plants. The science and engineering that goes in the manufacture of PCM is more exact and chemists and chemical engineers should get geared to using more rigorous tools. Multidisciplinary research will become essential. This will be a new feature in our industry in India, where such collaborative efforts are unheard of.

W.R. Grace and company, who excel themselves in speciality business employ, for every 100 scientists and engineers, six or seven commercial planning professionals with MBA degrees and backgrounds in technology, three to four consulting engineers and one financial professional for the purpose of setting priorities in business. Do we have the right professionals? Do we have the right consultants for PCM business? I classify the consultancy firms in India into three types: market research, coordinating and engineering. I do not find any science based consultancy firms in the country, which we precisely need! I again emphasise that success in this business depends upon several factors such as the ability to differentiate and value add, superior R & D in both qualitative and quantitative terms, aggressive marketing, providing effective pre-sales and post-sales services, great sensitivity to customer needs, recognising that skilled people are the most valuable assets in this business and having the right type of 'corporate' structure with quicker and bold decision making. It also requires an appreciation of the key role of interdisciplinary and team effort, sometimes transcending national boundaries. Globalisation of both business and R & D is a major factor. It requires captains with drive and vision. In short, a new attitude or a new culture only is what will make things happen in the chemical industry of tomorrow.

OTLIGHT ON INORGANIC CHEMICALS

Orthophosphoric Acid

(Wet Process)

B.A.V.K. SHARMA*

roduction

Orthophosphoric acid is produced by the action of an inor-nic acid on phosphate rock and the by-product being the cium salt of the acid used. The main reactions are as fol-ws.

$$Ca_3(PO_4)_2 + 4H_3PO_4 + 3H_2O \xrightarrow{200\text{-}300^\circ F} 3CaH_4(PO_4)_2\ H_2O$$

$$CaH_4(PO_4)_2H_2O + 3H_2SO_4 + 3H_2O \rightarrow 3CaSO_4.2H_2O + 6H_3PO_4$$

$$\text{a) } Ca_3(PO_4)_2 + 3H_2SO_4 \xrightarrow[(30\%\ P_2O_5)]{175^\circ F} 3CaSO_4\ 2H_2O + 2H_3PO_4$$

$$Ca_3(PO_4)_2 + 3H_2SO_4 + 1\ 1/2\ H_2O \xrightarrow[(42\%P_2O_5)]{215^\circ F} 3CaSO_4.1/2\ H_2O + 2H_3.PO_4$$

$$Ca_3SO_4\ 1/2\ H_2O + 2H_3PO_4 + 4\ 1/2\ H_2O \xrightarrow[\text{Dilution}]{\text{Cooling}} 3CaSO_4.2H_2O + 2H_3PO_4$$

I. $Ca_3(PO_4)_2 + 6HNO_3 + 12H_2O \rightarrow 3Ca(NO_3)_2.4H_2O + 2H_3PO_4$

/. $Ca_3(PO_4)_2 + 6HCl \rightarrow 3CaCl_2 + 2H_3PO_4$

. $Ca_3(PO_4)_2 + 3H_2SiF_6 \rightarrow 3CaSiF_6 + H_3PO_4$

I. $Ca_3(PO_4)_2 + 6HF \rightarrow 3CaF_2 + 2H_3PO_4$

The phosphoric acidulation of rock phosphate is not in actice except to make triple superphosphate but can be used r the manufacture of pure orthophosphoric acid. The mono-lcium phosphate produced in the reaction I is crystallised d dissolved in water. The calcium ion is removed by sul-uric acid or by ion exchange. The acidulation of rock phos-ate with sulphuric acid is a process universally practised produce phosphoric acid. Nitric acid acidulation of rock osphate as shown in reaction III is important where sul-ur is not available. Calcium nitrate is removed by crys-llistion and converted into ammonium nitrate which is a trogenous fertiliser.

Managing Director, Sharma Consultancy Services (Madras) Pvt. Ltd., 11, d Street, 3rd Main Road, C.I.T. Extension, Nandanam, Madras 600 035.

Hydrochloric acidulation of rock phosphate gives a mixture of calcium chloride solution & phosphoric acid. Phosphoric acid is separated by solvent extraction and the solvent used can be recovered by evaporation and distillation. Low grade rock phosphate and (cheap by-product of chlor-alkali industry) hydrochloric acid can be used.

Hydrofluosilicic acid, a by-product of phosphoric acid industry can be used to produce phosphoric acid by acidulating rock phosphate as shown in reaction V. The reaction VI is not practiced.

Raw material

The raw materials required are mainly rock phosphate and sulphur.

Rock phosphate

Rock phosphate exists principally as a carbonate fluorapatite with the formula $Ca_{10}F_2(PO_4)_6$ x $CaCO_3$ and most of these phosphates are formed by reprecipitation of dissolved phosphates from prehistoric seas. The process of reprecipitation is still going in the sea. Phosphate rock occurs abundantly throughout the world and is mined extensively in every continent.

The phosphate rock, for example, Jordan rock analysed as follows:

P_2O_5	32.60%
CaO	50.70%
SiO_2	3.00%
Fe_2O_3	0.20%
Al_2O_3	0.35%
MgO	0.58%
F	3.63%
SO_3	0.65%
CO_2	4.98%

The phosphate rock selected should be of reactive type if not the digestion with sulphuric acid takes a longer time and creates difficulty in filtering gypsum from phosphoric acid slurry. Further the rock phosphate should be of 65-70 BPL. The $CaO:P_2O_5$ ratio should be as low as possible to economise in the use of sulphuric acid and to avoid too much of foaming requiring the use of defoaming agents in larger quantities. The organic impurities in the rock can also cause foaming, interfere with filtration of gypsum and give black colour to the phosphoric acid. Very fine silica less than 50 μ particle size also interfere with filtration and if reactive silica

is not present, corrosion will be too severe. Fluorine which is present in a fairly constant $F:P_2O_5$ ratio of about 0.12 may also interfere with filtration, in addition to the corrosion, scale and sludge formation. Aluminium and iron impurities should be less than 3.5% and they form water insoluble phosphates, causing P_2O_5 losses and sludge problems. Chloride can cause increased corrosion problems. Sodium and potassium form sludge forming fluosilicates.

Sulphur

The process for the manufacture of phosphoric acid requires almost one ton sulphur to convert into sulphuric acid for each ton of P_2O_5. The source of sulphur is brimstone, sour natural gas, refinery gas and smelter stack gas. Pyrite ore is an important source of sulphuric acid. A major potential source of sulphuric acid is naturally occuring calcium sulphate or phosphogypsum.

Another source of sulphuric acid is sulphur dioxide from stack gases from fossil fuel-burning power plants. By-product sulphuric acid free from organic impurities can also be used. Generally, sulphuric acid is produced in a captive plant and the advantage is to supply phosphoric acid process steam requirements and heat for concentrating the phosphoric acid in vacuum evaporators.

Certain additives are also used in phosphoric acid manufacture: defoaming agents like oleic acid, organic compounds like linear alkyl benzene sulphonate to help the crystal growth and aid ease of filtration. Other additives used are active silica and calcium carbonate.

Chemistry

Phosphoric acid is extracted from rock phosphate by reacting with sulphuric acid of various concentrations and temperatures along with recycled phosphoric acid or gypsum slurry. The generalj reaction is represented as follows:

$$Ca_{10}(PO_4)\ 6F_2 + 10H_2SO_4 + 10nH_2O \dashrightarrow 10CaSO_4nH_2O + 6H_3PO_4 + 2HF$$

Where 'n' ranges from 0 to 2. The impurities in the rock react as follows:

$$CaCO_3 + H_2SO_4 + nH_2O \dashrightarrow CaSO_4.nH_2 + H_2O + CO_2$$
$$CaF_2 + H_2SO_4 + nH_2O \dashrightarrow CaSO_4.nH_2O + CO_2 + 2HF$$
$$6HF + SiO_2 \dashrightarrow H_2SiF_6 + 2H_2O$$
$$H_2SiF_6 \dashrightarrow SiF_4 + 2HF$$
$$3SiF_4 \dashrightarrow H_2SiF_6 + SiO_2$$
$$X_2O_3 + 2H_3PO_4 \dashrightarrow 2\ XPO_4 + 3H_2O$$
$$(X = Al \text{ or } Fe)$$

The basic objective of preparing phosphoric acid from phosphate rock and sulphuric acid is to obtain the highest concentration of phosphoric acid possible with the maximum yield. The characteristics of calcium sulphate crystals formed during the reaction are the most important fundamental factor in phosphoric acid production. All the commercial wet processes that have been proposed for phosphoric acid can be classified depending on the way the calcium sulphate or varying hydrates are crystallised.

1. Continuous pure dihydrate or hemihydrate or anhydrite crystallisation.
2. Continuous primary dihydrate crystallisation and recrystallisation into hemihydrate and vice versa before crystallisation.
3. Continuous crystallisation of hemihydrate with simultaneous crystallisation of dihydrate.
4. Continuous primary hemihydrate crystallisation and anhydrite recrystallisation.
5. Production of anhydrite clinker followed by leaching.

Complete designs for manufacturing phosphoric acid plants which differ in detail rather than principles are offered by Dorr-Oliver, Prayon, Fisions,Chemico, Singmaster & Breyer, PSG-UCB etc. for dihydrate process. Hemihydrite and anhydrite processes plants are offered by Mitsubishi, Nissan, NKK, Singmaster & Breyer, TVA, etc.

The various wet processes developed are helping to reduce the loss of P_2O_5 in the washed filter cake arising out of:

1. Incomplete washing of cake.
2. Coating of rock phosphate particles with dicalcium phosphate and subsequent overgrowth with calcium sulphate resulting in incomplete extraction.
3. Trapping of phosphate solution in cavities in the calcium sulphate crystals.
4. Intergrowth of layers of monocalcium monohydrate with calcium sulphate crystals.
5. Incorporation of P_2O_5 in the calcium sulphate crystal lattice.

Ortho phosphoric acid produced by the above methods is concentrated to 54% P_2O_5 by vacuum evaporation and clarified to remove impurities or inhibit precipitation of impurities that may create problems in handling and transportation.

Various methods have been proposed to manufacture phosphoric acid of concentration of 54% P_2O_5 or so without a concentration step. One such process is patented by Coleman of Southern Phosphate Corpn., using phosphoric acid to form a $CaO:P_2O_5$ ratio 1:1 to 1:2 and treating the same with sulphuric acid after calcination.

A process is patented by Shoeld of Devison Chemical in which superphosphate is treated with sulphuric acid to obtain a product acid containing 40 to 50 per cent P_2O_5.

The disposal of by-product gypsum is a problem increas-ng in severity with anti-pollution regulations. There are mportant methods for utilising by-product gypsum.

1. Convert the gypsum to plaster.
2. React the gypsum with ammonium carbonate in the Mersberg Process to produce ammonium sulphate and calcium carbonate.
3. Recover sulphuric acid from gypsum.

In the processes 2 & 3, the calcium carbonate formed is used for cement manufacturing. Plaster manufacture from gypsum is based on the process developed by Giulini GmbH, W. Germany and I.C.I.

The fluorine compounds evolved during digestion of rock with sulphuric acid & during evaporation is converted into hydrofluosilicic acid of about 33 per cent concentration and silica. Various process are available to convert fluosilicic acid to various commercial fluorine compounds and also to convert waste silica into precipitated silica used as a filler in rubber.

Uranium can be recovered from wet process phosphoric acid by solvent extractions by adopting DEPATOPO and the OPAD processes and thereby a conservation of a nuclear fuel resource can be effected and also the radioactive fertiliser contaminant is removed. It is estimated that wet process phosphoric acid produced in a year will contain about 10,000 tonnes of dissolved U_3O_8.

(to be continued)

News from Japan

20 MITSUI GROUP FIRMS START PLANT BIOTECH RESEARCH COMPANY

Twenty Japanese companies belonging to the Mitsui group jointly established a plant-biotechnology research company as of August 1 by reorganizing and making into an independent company a research organization comprising 14 Mitsui-group companies. The new company called Mitsui Plant Biotechnology Research Institute — the same name as that of the former organization — has its own research base at Tsukuba and is designed to carry out research activities such as separation and analysis of plant genes, aiming at commercial application of their research results.

The new institute has moved to a research building owned by Tsukuba Center Inc. at Tsukuba Academic New Town and is now setting up the necessary facilities and equipment including those for experiments using radioisotopes. Staff members of the former organization conducted research work at a number of universities where they were sent to join the activities of academic researchers.

They are now able to tackle research themes stemming from the corporate strategies of the 20 Mitsui group companies participating in the new institute. Through joint research at universities, they have already achieved prominent results such as the determination of the whole base arrangement of rice chloroplast DNA, the discovery of a promoter appearing at the time of rice-seed germination and the identification and analysis of pine DNA.

ASAHI CHEM. TO RAISE ETHYLENE PRODUCTION TO 440,000 TONNES/YEAR

Asahi Chemical Industry is considering boosting its production capacity for ethylene by 40,000 tonnes/yr. and establishing a 440,000 tonnes/year production system by the spring of 1990. The company intends to achieve this goal by restarting two idled crackers and improving some of the refining processes concerned. This capacity expansion is aimed at rectifying the tight supply-and-demand situation for ethylene stemming from favourable production of its derivatives. As the company already enlarged its production capacity for ethylene by 50,000 tonnes year last year, it will launch no more programs for expansion of existing plants for the time being.

Asahi Chemical's production base for the petrochemical business is Mizushima Seisakusho (Okayama Prefecture). This large complex complements the adjacent Mizushima complex of Mitsubishi Kasei. In order to cope with increased ethylene demand within the complex, Asahi Chemical boosted its production capacity for ethylene by 50,000 tonnes year by means of restarting an idled cracker and adjusting the operating conditions of ethylene crackers last year. As a result, it has established a 400,000-tonnes year production system.

The company submitted the said latest capacity enlargement plan to MITI in June. It indicates that there is a high rate of self-consumption within the complex. For coping with increased demand it continues to produce various types of ethylene derivatives, such as HD-PE, LDPE, acrylonitrile, styrene monomer, polystyrene and ammonia, running its facilities at nearly full capacity.

GENERAL PETROCHEMICAL INDUSTRY TO ENTER INTO PX MARKET

General Petrochemical Industry — capitalized 100% by General Sekiyu — has announced that it will launch commercial production of p-xylene (PX) (150,000 tonnes/year) by next September. The company will commence construction of a PX plant employing UOP's Parex and isomer processes on the site of General Sekiyu's Sakai oil refinery from the autumn. The investment funds concerned reach Yen 14 billion.

General Sekiyu has already inaugurated commercial production of benzene (30,000 t/y), toluene (120,000 t/y) and xylene (150,000 t/y) as part of its strategy of strengthening downstream within the said refinery. In order to give added value to xylene, General Petrochemical Industry has decided to initiate PX production.

TOKUYAMA SODA PUTTING FULL WEIGHT BEHIND FULFILLING 5-YEAR PLAN

Tokuyama Soda Chairman Yasuharu Onoue and President Kaoru Tsuji recently held their first press interview since assuming their current positions. During the course of discussions, Onoue reflected on his years as former president while Tsuji resolved to promote the company's new 5-year management plan, strengthen R & D, foster new business areas, reinforce basic businesses, and respond positively to industrial globalization. In addition, Tsuji shared his aspirations as new president.

"Exactly seven yrs. have passed since I became president of Tokuyama Soda in 1982. I also celebrated my 70th birthday this February, and therefore feel very fortunate to have found and handed over the reins to my successor, Management has been entrusted to a younger group and thus renewal has been effected. With the exception of myself, all members of the present management team were born during the Showa Period (After 1925).

From now on, I hope the new president will freely display the energy of youth in building

and maintaining the business environment both inside and outside the company. Since he comes from a technical background, I am sure he will provide a broad perspective in shaping both R & D and overseas business activities." (Onoue).

"Since the oil crisis, Tokuyama Soda has taken measures to deal effectively with energy needs, and I'm happy to say that this process has been completed. With the past several years of favourable business performance behind us, we have successfully upgraded and restructured our manufacturing facilities. Thus, I feel that I assumed the presidency under the best possible conditions.

From this day forward, we will attach primary importance to the excecution of our new five-year management plan, which I helped formulate last year. Moreover, as an integral part of this, we will channel energies into creating an atmosphere of spiritural acclimatization through a process of self-transformation dubbed "The Papillion Strategy," while at the same time exerting companywide efforts to advance into the next-generation field of meta-chemicals.

Strengthening R & D capabilities is another important theme for us. To illustrate, we completed a new Tsukuba research laboratory in May, which gives us a system comprising four R & D labs and one centre. We will make assiduous efforts to realize successes from this system in the future.

Our new business division (Specialty Products Division) is shaping up nicely around such products as diagnostic agents, dental materials, and aluminium nitride ceramics. We will continue to strengthen this division's earnings potential and planted the seeds, I feel it is my responsibility to cultivate the buds that are now beginning to sprout.

While the feeling exists that most of our basic business lines are reaching maturity, I think it is possible to realize further growth by heightening added value. We will therefore attach equal emphasis to strengthening both basic and new business operations.

Overseas, we are mapping out vigorous steps to promote the globalization of Tokuyama Soda. In the United States, for example, we have already acquired General Ceramics Co., and we have incorporated our branch office in that country. We are also producing white carbon in Thailand. Furthermore, it is our intention to secure a base in Europe within this year.

We have established IRIS (Integrated Restructuring of Information System) Dept. and are aggressively pursuing the restructuring of information systems. The company is aiming for completion of the first phase within the next two years. In addition, our information center located inside the Tokuyama manufacturing facilities has recently been finished. We hope to heighten the strategic value of the center while making steady progress in diversifying products and expanding networks.

This year, Tokuyama Soda's total loans and investments will be in the neighborhood of Yen 20 to 25 billion. The bulk of capital investments will be applied to our Tsukuba research laboratory and for rebuilding poly-propylene facilities. Application of the remaining amount is scheduled for apportionment between bolstering manufacturing facilities for early next year), epichlorohydrin, and electrolyzers, and for OPP films (due for completion streamlining cement distribution. (Tsuji)."

SEED GROWING BH 7%: MITI WORLD DRY-CELL PRODUCTION

The Ministry of International Trade and Industry (MITI) has attempted a long-term forecast for dry-cell operations covering the period up to the year 2000. According to MITI, Japanese production of manganese batteries will decline and be taken over by producers located in NIEs and ASEAN-member countries.

Output of alkaline batteries will show an annual growth rate of 10%. They will exceed manganese batteries in terms of production value in 1995 and do so in terms of production volume in 2000. Production of lithium batteries is reckoned to attain a surprisingly high annual growth rate of 15%. They will be increasingly employed as back-up power sources for industrial-use machinery and electrical power sources for electronic cameras.

Japanese production of dry batteries in 1988 stood at 3,780 million units, about 30% of which were exported. Their outlets rapidly expanded in response to the development of the transistor in the 1950s. Application of electronics to consumer appliances in and after the late 1960s has resulted in the development of new-type batteries.

Combined production of dry batteries in 1988 for the whole world except the Communist bloc reached 3,800 million in value (manganese batteries, 51%; alkaline ones, 36%; lithium ones, 5%). The United States and Asia accounted for 52 and 63% of the production of manganese and alkaline batteries, respectively.

New Developments from Japan

POLYCARBONATE-BASED OPTICAL FIBRE SAID EFFICIENT : ASAHI CHEMICAL

Asahi Chemical Industry Co. has developed a polycarbonate (PC)-based heat-resistant optical fibre and marketed it under the "Luminus XH-1000" trade name.

The new product is capable of tolerating temperatures of up to 125°C and its transmission loss stands at 0.6 db/m in the case of a wavelength of 770 nm and a temperature of 120°C. The loss is below one-sixth that of the PC-based optical fibres now in use, though it is still higher than in the case with MMA-based products.

Potential applications of the new product are car parts including automotive-use audio equipment and navigation systems. It is reckoned to be effective against electromagnetic interference affecting engine-controlling systems.

The product can transmit more than five times as much information as copper wire. It is, therefore, capable of reducing the amount of copper wire needed for information transmission and economizing on the space for setting it.

The company has already commercialized MMA-based optical fibre and is aiming at building up optical-fibre operations using the new product. It buys raw material PC resin from an outsider company.

MMA-based optical fibre is the dominant type of plastic optical fibre. Its tolerable temperature is up to about 105°C even when covered with specialty material or the resin concerned is modified.

PC-based optical fibre has high thermal resistance but is inferior in optical properties to MMA-based ones. Compared with the latter, the former is, therefore, suitable for shorter distances.

LONG-LIFE AMORPHOUS POWDER FOR STORING HYDROGEN BARED

Sanyo Electric Co. has developed a hydogen-absorbing and releasing amorphous alloy undergoing no change of volume when in use and having longer service life.

The new alloy is fine amorphous powder made by means of solidification of a lanthanum-nickel alloy prepared by the arc melting method. Conventional hydrogen-absorbing and-realising allows go through volume changes in the course of absorption and releasing, and are thus gradually converted into fine powder, resulting in a decrease in storage capacity, a company official says. The new alloy is free from such a disadvantage.

It does, however, have one problem in that there is a great diffierence of hydrogen pressures at the times of absorption and releasing. For practical application, it may be necessary to mix it with a crystalline hydrogen storage alloy or make it into a composite alloy using the crystalline alloy, he explained.

The company has also developed an alloy with similar functions using a titanium-iron alloy. It intends to continue application development for the new-type alloys for hydrogen storage.

ORTHODONTIC BRACKET PRODUCED FROM ZIRCONIA CERAMIC : TORAY

Toray Industries, Inc. has pioneered an orthodontic bracket using an inhouse-developed high-strength zirconia ceramic (trade name : Torayceram). The company has been tackling related R & D work since four years ago in collaboration with College of Dentistry, Tohoku University.

The new product has the following advantages: (1) it has nearly the same gloss as do natural teeth and so does not ruin the appearance of the mouth; (2) it does not cause allergies resulting from elution of metal ions and (3) its high strength and rigidity ensure good workability of the product itself for dentists.

The company has produced the bracket using unique injection-molding technology. Zirconia ceramic's high strength, surface smoothness, biocompatibility and heat-insulation properties are all present in the new product.

The product is three times as strong as an orthodontic bracket made from high-purity alumina and presents almost no problem at all with regard to causing teeth caries.

The company has started marketing the new product at a unit price of Y 850. The annual sales target is set at 100,000 pieces for the initial year and one million pieces for three years hence.

"Torayceram" zirconia ceramic was developed in 1986 and has the world's highest strength and tenacity. It has hitherto been applied to edged tools and machinery parts. The orthodontic bracket is the first medical application of the ceramic.

There are about 600,000 Japanese undergoing orthodontics. It is forecast that roughly 200,-300,000 people in Japan will newly require every year correction of the irregularities of their teeth.

TOKUYAMA SODA TO ADD DENTAL MATERIALS INTERMEDIATES

Tokuyama Soda Co. aims at increasing production capacity for dental materials by 50% and doubling the size of a multipurpose organic-synthesis plant for drug/agrochemical intermediates at its Kashima factory (Ibaraki Prefecture). Related construction has been inaugurated and most of it is scheduled to be completed by year-end.

Dental materials and diagnosis agents are two mainstay items in the company's medical business, into which the company recently diversified. The multipurpose plant is capable of producing bulk drugs and intermediates for pharmaceuticals, agrochemicals, dyes and pigments: it is suitable for small-lot-and-wide variety production.

The Kashima factory is the company's production base for high-tech operations incorporating production facilities for dental materials, water-soluble dry-film photo resist and intermediate materials.

In its 5-year business plan, the company intends to build up new business fields, thereby raising the share of related sales to 45% in the target year for the plan. From this point of view, the factory will be further scaled up some time in the future.

MITI TO WORK OUT GUIDELINE FOR FAR INFRARED-RAY CERAMICS

The Ministry of International Trade and Industry (MITI) has begun to compile a guideline covering the evaluation of measuring methods for and efficiency of far infrared radiation-emitting ceramics.

Under MITI's support, a special committee has been organized within Japan Fine Ceramics Association to map out the standard. The committee is composed of researchers and experts in the fields of foodstuffs, medicines and ceramics belonging to universities, national research laboratories and private corporations.

The step is intended to help bring about the sound development of the far infrared radiation-ceramics industry which has been expanding fast in recent years in Japan. There are two types of such ceramic products; one is of the heat-applied type used for curing, warming and drying in a variety of fields and the other is the type without heat application.

The latter type emits minute radiation energy at room temperature and has been utilized for underwear, carpets and sheets as well as food preservation. This use has been growing rapidly in recent years and it is said that the number of makers involved in this line — mostly small-and medium-scale companies — has increased to a few hundred with their market growing by 2.5 times over the last three years.

GI PLASTIC OPTICAL FIBRE FOR PRACTICAL USE DEVELOPED BY KEIO UNIVERSITY

A group led by Y. Otsuka (Dean of the Science and Engineering Department, Keio University), has succeeded in deveoping a gradient-index (GI) plastic optical fibre with wide band transmission and low transmission loss, which is expected to replace the step-index (SI) fibres currently in use.

The GI optical fibre developed by the Otsuka group, which has a particularly low transmission loss and five times the bandwidth of SI optical fibres, may broaden the transmission band by approximately one order of magnitude due to improved fibre transparency. This development is noteworthy, in that it makes practical applications for GI optical fibres possible.

Although plastic optical fibre's transparency is inferior to that of glass optical fibre, it has other advantages, such as ease of manufacture, high shock resistance, and a wider aperture. As such, it is used as a short-range transmission medium in data-links, LAN, HAs, etc. The type of plastic currently in use in optical fibres are expected to be implemented in the future due to the extended transmission band capacity in high-level transmissions.

The GI optical fibre developed by the Otsuka group is derived through the process used for making polymeric tubes (outer diameter 10mm, inner diameter 6mm), using methacrylate as a matrix, benzoyl peroxide (BPO) as a polymerization initiator, and n-butyl mercaptan as a chain transfer reactor. After fixing the tubes' refractive index range by decreasing the refractive index from core to ambient, they are put through a continous-heat stretching process, resulting in an optical fibre with a diameter of 1mm.

These GI fibres turned out to have an unexpected low transmission loss value of 142.5dB/Km at a wavelength of 650.7nm. Accordingly, the Otsuka group's GI plastic optical fibre is expected to have practical applications.

International Bulk Chemical Prices

Spot Prices are as on September 20, 1989

With weakening petrochemicals demand naphtha prices which rose to $156-157 ton cif NWE, is expected to lower. Ethylene prices rose to $320-330/ ton cif NWE with unscheduled shutdowns in two plants. Trading in propylene declined following lack of ready materials. Butadiene remained extremely tight with prices quoted at $415-425/ton fob NWE. Acute shortage of benzene pushed prices to $365-375/ ton fob NWE.

Rising benzene prices pushed prices of toluene to $260-265/ton fob Rotterdam. Activity in paraxylenes remained quiet with prices at $640-643/ton fob NWE. Ortho xylene remained stable. With abundant availability xylene prices came down to $280-285/ton. Styrene prices stabilised at $640-645/ton cif NWE. Methanol prices have moved up with T1 quoted at $70-75/ton cif NWE and T2 at DM140-145/ton fob NWE.

Product	European Spot price range $/ton	US price range $/ton
Ethylene	320-330 (cif)	n.a
Propylene (100% basis)	425-435 (cif)	352 (spot)
Butadiene	415-425 (fob)	551-595 (spot)
Benzene	365-375 (fob)	357-360 (spot)
Toluene	260-265 (fob)	234-237 (spot)
Xylenes (virgin)	285-290 (fob)	264-266 (spot)
(solvent)	280-285 (fob)	n.a.
Styrene	670-680 (T2)(fob)	573-617 (spot)
	640-645 (T1) (cif)	
Paraxylene	640-643 (fob)	n.a.
Orthoxylene	320-328 (fob)	n.a.
Ammonia	88-102 (c&f)	n.a.
Methanol	71- 74 (T2)(fob)	n.a.
	70- 75 (T1)(cif)	
Naphtha	156-157 (cif)	n.a.

Shipping News

VESSELS DUE IN BOMBAY FOR EXPORT LOADING

Due Date (1)	Steamer's Name & Flag (2)	Agents (3)	Will load for (4)	Approx. sailing dt. (5)
Stream	Katija Zelenko	Transocean	Odessa	21/10
18/10	Medipas Sun	L. Triest/	Jeddah; Barcelona; Marseilles; Genoa; Leghorn; La Spezia; Naples; with TP. Trieste; Venice; Ravenna; Bari; Koper; Rijeka, Las Palmas; Santacruz De Teneriffe; Malta; Limmassol; Alexandria; Casablanca; Tunis; Algiers; Lattakia; Tripoli; Benghazi; Oran; Point E Pitre; Port De France. (Carting at M-171/173 Cotton Depot).	22/10
		Samrat/ Hindustan/	Barcelona; Marseilles; La Spezia; Livorna; (Loghorn); Genoa; Naples and other Italian ports and FCL only Beirut; Alexandria; Valletta; Lattakia; Mersin. (Carting at M.O.D. No. 1 for both).	
		Merzario	Genoa; Leghorn; La Spezia; Naples;Salerno; Marseilles; Barcelona. (Carting at M.O.D. No. 2).	
12/10	Ramdas (Ind)	S.C.I.	Copenhagen; Gothenburg; Helsinki and all inland destinations. (Carting at Timber Pond No.1).	26/10
14/10	Eagle Moon	F.F.C. Co.	Jeddah; P. Sudan; Hodeidah. (Carting at Timber Pond No. 1).	19/10
15/10	Uni Pioneer (V-015)(Pan)	Greenways	Hamburg; Felixstowe; Rotterdam; Antwerp; Le Havre; London; Liverpool; Leixoes; Lisbon; Manchester; Avonmouth; Wembly; Birmingham; Leeds; Leicester; Amsterdam; Bremen; Copenhagen; Aarhus; Gothenburg; Oslo; Stockholm; Helsinki; Belfast & all desinations in U.K.; Germany; Switzerland and Austria. (Carting at G/H Cotton Depot).	21/10

(1)	(2)	(3)	(4)	(5)
16/10	Orient Express (Pan)(Voy-102)	Transworld	Hodeidah; Djibouti; Port Sudan; Jeddah; Assab; Masawa; La Spezia; Naples; Malta; Beirut; Tartous; Mersin; Marseilles; Genoa; Valencia; Fos; Leghorn; Tilbury; London; Liverpool; Avonmouth; Birmingham; Manchester; Leeds; Dublin; Belfast; Antwerp; Hamburg; Bremen; Rotterdam; Le Havre; Aarhus; Gothenburg; Helsingborg. (Carting at CFS Avenue).	19/10
18/10	Integra	P&O	Assab; Djibouti; P. Sudan. (Carting at Timber Pond No. 4).	21/10
19/10	Maersk Clementine	Volkart Fleming	Leghorn; Marseilles; Naples; Barcelona; Bilbao; Bordeaus; Alicante; Genoa; Valencia; Bremen; Jeddah; Antwerp; Rotterdam; Bremerhaven; Hamburg; U.K. & Scandinavian ports. (Carting at M.O.D. No. 3).	23/10
21/10	Aries (V-701) (Cyp)	Killick/	Jeddah; Felixstowe; London; Liverpool; Manchester; Bristol; Avonmouth; Leeds; Glasgow; Tilbury; Birmingham; Dublin; Belfast; Rotterdam; Hamburg; Le Havre; Antwerp; Bremen; Bremerhaven; Fos; Valencia; Marseilles; Barcelona. (Carting at M-178/180 C.D.).	26/10
		Merzario/	Jeddah; Hodeidah; P.Sudan; Ravenna; Ancona; Piraeus; Venice; Trieste. (Carting at M.O.D. No. 2).	
		Seaspeed/	Tilbury; London; Felixstowe; Manchester; Liverpool; Avonmouth; Le Havre; Rotterdam; Hamburg; Antwerp; Bremerhaven and Scandinavian Ports. (Carting at Hay Bunder No. 3).	
		L. Triest/	Jeddah; Trieste; Venice; Ravenna; Rijeka; Naples. (Carting at M-171/173 C.D.).	
		Choice	Leghorn; Marseilles; Valencia; Genoa; Cadiz; Barcelona; Ravenna; Venice; Naples; Trieste; La Spezia and other inland destinations. (Carting at 19-ID).	
18/10	Medipas Sun	L. Triest	Colombo. (Carting at M-171/173 Cotton Depot).	22/10
14/10	Eagle Moon	F.F.C. Co.	Colombo; Rangoon. (Carting at Timber Pond No. 1).	19/10
16/10	Supanya	Silvership	Chittagong. (Carting at 19-ID)	21/10
14/10	Eagle Moon (V-019)(Ger)	F.F.C. Co.	Penang; P. Kelang; Singapore; Bangkok; Jakarta (T. Priok); Hongkong; Manila; Busan; Keelung; Kaohsiung; Kobe; Yokohama; Nagoya; Osaka; Tokyo; Tsingtao; Dairen; Quangzhou; Whampoa; Shanghai; Hsingkang. (Carting at Timber Pond No. 1).	19/10
15/10	Uni Pioneer (V-015)(Pan)	Greenways	Singapore; Penang; Port Kelang; Bangkok; Djakarta; Surabhaya; Manila; Cebu; Kaohsiung; Keelung; Osaka; Yokohama; Kobe; Shimizu; Moji; Nagoya; Pusan; Hongkong. (Carting at G/H Cotton Depot)	21/10
16/10	Supanya (V-29) Thai	Samrat/	Singapore (Direct); Penang; Jakarta; Surabaya; Belawan; P. Kelang; Bangkok; Manila; Hongkong; Kaohsiung; Keelung; Taichung; Busan; Yokohama; Nagoya; Kobe; Osaka; Tokyo. (Crtg. at Mallet Bunder).	21/10
		Trident/	Busan; Hongkong; Keelung; Kobe; Nagoya; Yokohama; Penang; P. Kelang; Bangkok; Kaohsiung; Singapore. (Carting at 7-W/H-PD).	
		U.L.A./	Singapore; Penang; P. Kelang; Keelung; Kaohsiung; Bangkok; Busan; Jakarta; Hongkong; Japan & Chinese ports. (Crtg at M-171/173 CD).	
		E.S.P.L.	Dalian; Quindao; Tianjin (Xingang); Nawtong; Shanghai; Ningbo; Xianmen; Fuzhou; Guangzhou; Whampoa; Vietnam. (Crtg. at M.B.).	
		Transworld/	P. Kelang; Penang; Keelung; Kaohsiung; Busan; Bangkok; Kobe; Yokohama; Nagoya; Tokyo; Shimizu. (Carting at M-178/180 C.D.).	
		I.M.E.	Singapore; Bangkok; Hongkong; Keelung; Busan; Kobe; Yokohama; Nagoya. (Carting at Wadi Bunder No. 3).	
		Silver Ship/	Singapore; Far East and Japan ports. (Carting at 19-ID).	
		M.C.S.	Singapore; Hongkong; Keelung; Kaohsiung; Jakarta; Surabaya; Bangkok; Penang; P. Kelang. (Carting at H.B. No. 4 for M.C.S.).	
19/10	Maersk Clementine (Sing)(V-8932)	Volkart Fleming	Penang; Singapore; Hongkong; Keelung; Kaohsiung; Busan; Main Japan Ports; Manila; Jakarta; Surabaya; Bangkok; P. Kelang; Chinese Ports. (Carting at M.O.D. No. 2).	23/10
16/10	Supanya	Samrat/	Brisbane; Sydney; Melbourne; Adelaide; Fremantle; Burnie. (Carting at Mallett Bunder).	21/10
		Trident/	Brisbane; Sydney; Melbourne; Adelaide; Fremantle; Burnie; Auckland; Wellington; Lyttleton. (Carting at 7-W/H-PD).	
		Arebee/	Sydney; Melbourne; Adelaide; Brisbane. (Carting at M-Jetha C.D.).	
		Transworld/	Sydney; Melbourne; Adelaide; Fremantle; Burnie; Brisbane. (Carting at M-178/180 Cotton Depot).	

(1)	(2)	(3)	(4)	(5)
		Kanika/	Brisbane; Sydney; Melbourne; New Castle; Adelaide; Fremantle; Auckland; Wellington; Lyttleton. (Carting at Timber Pond No. 3).	
		Silver Ship	Sydney; Melbourne; Brisbane; Adelaide; Fremantle; Auckland; Wellington; Lyttleton; P. Charlmers. (Carting at 19-ID).	
14/10	Eagle Moon	F.F.C. Co.	Brisbane; Fremantle; Sydney; Melbourne; Adelaide. (Crtg. at TP No. 1).	19/10
12/10	E. Kwiatkowski	Khemka	Kuwait; Dammam; Dubai	20/10
14/10	Eagle Moon (V-019)	F.F.C. Co.	Dubai; Sharjah; Abu Dhabi; Doha; Muscat; Dammam; Riyadh; Bahrain; Kuwait. (Carting at Timber Pond No.1).	19/10
16/10	Orient Express (V-102)(Pan)	Transworld/	Sharjah; Dubai; Abu Dhabi; Ajman; Doha; Kuwait; Dammam; Baghdad; Basrah; Syria and inland destinations in Gulf. (Carting at CFS Cotton Avenue).	19/10
		Sai Ship	Dubai; Muscat; Sharjah; Abu Dhabi. (Carting at Wadi Bunder No. 3).	
19/10	Maersk Clementine	V. Fleming	Dubai; Dammam; Muscat; Bahrain; Kuwait; Riyadh; Doha. (Carting at M.O.D. No. 2).	23/10
21/10	Aries (V-701) (Cyp)	Parekh/	Muscat; Dubai; Sharjah; Abu Dhabi; Bahrain; Dammam; Kuwait; Baghdad. (Carting at Hay Bunder No. 4).	25/10
		Choice/	Dubai; Dammam; Kuwait; Muscat; Bahrain; Abu Dhabi. (Carting at 19-ID).	
		Merzario/	Dubai; Sharjah; Abu Dhabi; Muscat; Doha; Dammam; Kuwait; Bahrain; (Carting at 14-VD for Merzario).	
		L. Triest/	Dubai; Dammam; Riyadh; Muscat; Abu Dhabi; Doha; Kuwait; Bahrain. (Carting at 171/173 Cotton Depot for Triest).	
		Seaspeed	Dubai; Dammam; Bahrain; Kuwait; Doha. (Carting at H.B. No. 5).	
18/10	Integra (V-12) (Pan)	Arebee/	Dar Es Salaam & Mombasa (Direct); Kampala; Jinja; Torroro; Lugazi; Entebee (Uganda); Kigali; (Rwanda); Kitwe; Lusaka; Ndola (Zambia); Lilongwe; Blantyre (Malawi): Maputo; Zanzibar. (Crtg. at M.J. C.D.).	21/10
		P&O	Mombasa; Dar Es Salaam (Direct); Beira; Mahe and inland destinations in East Africa. (Carting at Timber Pond No. 4).	
18/10	Medipas Sun	Samrat/ Hindustan	Boston; New York; Baltimore; Norfolk; Charleston; P. Mouth; P. Lauderdale; Miami; New Orleans; Savannah; Jacksonville; P. Everglades; Philadelphia; Halifax; Montreal; Toronto and S. American ports. (Carting at M.O.D. No. 1 for both).	22/10
12/10	Ramdas (Ind)	S.C.I.	New York; Baltimore; Savannah (Direct); and other inland destinations. (Carting at Timber Pond No. 1).	26/10
14/10	Eagle Moon (V-019)	F.F.C. Co.	Los Angeles (Harbour); Longbeach; Sanfrancisco; Oakland; Seattle; Vancouver (B.C.); Portland; New York; Boston; Norfolk; Baltimore; Charleston; Savannah; Miami; New Orleans; Houston; Montreal; Toronto; Fortworth; Chicago; Nashville; Atlanta; Philadelphia; Milwaukee; Kansas City; Phoenix; Guam; Dallas; Cleveland; St. Louis; Cincinnati; Denver; Louisville; Memphis; Wilmington (B.C.); San Diego; Minneapolis; Indianapolis and Central American ports; Honolulu. (Carting at Timber Pond No. 1).	19/10
15/10	Uni Pioneer (Voy-015)	Greenways	New York; Newark; Baltimore; Charleston; New Orleans; Houston; Boston; Providence (RI): Philadelphia; Norfolk; Savannah; Jacksonville; Wilmington; Miami; Montreal; Toronto; Bermuda; Los Angeles; Longbeach; Sanfrancisco; Oakland; San Diego; Stockton; Richmond; Almeida; Redwood City; Sacramento; Seattle; Portland; Vancouver (B.C.); Tacoma; Longview; Chicago; Dallas; various inland destinations & Caribbean ports. (Carting at G/H C.D.).	21/10
16/10	Orient Express (Voy-102)	Transworld	Los Angeles; Longbeach; Sanfrancisco; Oakland; Seattle; Vancouver; New York; Boston; Toronto; Montreal; Philadelphia; Norfolk; Baltimore; Charleston; Savannah; Jacksonville; Miami; New Orleans; Houston. (Carting at CFS Cotton Avenue).	19/10
16/10	Supanya (V-29)	Samrat/	Longbeach; Oakland; Seattle; Los Angeles; San Francisco; Philadelphia; Savannah; Charleston; Baltimore; Norfolk; New York; Boston; St. John; Vancouver; Montreal; Toronto; New Orleans; Houston. (Carting at M.B.).	21/10
		U.L.A./	Los Angeles; Sanfrancisco; Oakland; Seattle; Vancouver; Charleston; Houston; Norfolk; Baltimore; New York; Halifax; Montreal; Toronto; S. American and W. Indies ports. (Carting at M-171/173 C.D.).	
		E.S.P.L./	Longbeach; Charleston; New York; St. John; Norfolk; Oakland; Vancouver (B.C.); Seattle; Montreal; Baltimore; Boston; Chicago; Dallas; Houston; Longview; Los Angeles; New Orleans; Philadelphia;	

(1)	(2)	(3)	(4)	(5)
			Portland; San Diego; Mexico City; Sanfrancisco; Siouxfall; Sacramento; Stockton; Halifax; Toronto; Savannah; Tacoma; Miami and other Destinations. Also Caribbean ports. (Carting at Mallet Bunder).	
		Trident/	S. American; Caribbean & Central American ports. (Carting at 7-W/H-PD).	
		Arebee	S. American ports. (Carting at M-Jetha Cotton Depot).	
18/10	Hoegh Clipper (Pan)	Patvolk	Montreal & Toronto via Halifax; New York; Boston; Norfolk; Charleston; Houston; Savannah; Wilmington; Philadelphia; Baltimore; New Orleans & FCL Chicago; Milwaukee; Atlanta; Dallas. (Carting at H.B. No. 5).	23/10
19/10	Maersk (Clementine (Sing)(V-8932)	Volkart Fleming	New York; Philadelphia; Baltimore; Norfolk; Charleston; Savannah; Jacksonville; Miami; New Orleans; Houston; Toronto; Montreal; Chicago; Atlanta; Denver; Dallas; Wilmington; Milwaukee; Detroit; Minneapolis; Memphis; Nashville; Cleveland; Phoenix; Boston; Los Angeles; Vancouver; Seattle; Sanfrancisco; Portland; Longbeach; Mexican and S. American ports. (Carting at M.O.D. No. 2).	23/10
21/10	Aries (Voy-701)	Seaspeed/	New York; Baltimore; Norfolk; Savannah; Charleston; Houston & S. American ports. (Carting at Hay Bunder No. 3).	26/10
		Oceanic/	New York; Baltimore; Philadelphia; Chicago; Boston; Norfolk; Atlanta; Charleston; Savannah; Miami; Houston and other inland destinations in US E. Coast & S. American ports. (Crtg. at Wadi Bunder No. 3).	
		Choice	New York; Baltimore; Norfolk; Savannah; Montreal; Toronto; Charleston; Houston; New Orleans; Miami; Tampa; Chicago and other inland destinations. (Carting at 19-ID).	
18/10	Medipas Sun	L. Triest	With T.P. Lagos/Apapa; Abidjan; Dakar; Douala; Cotonou; Nouakchott; Libreville; Tema; Matadi; Conakry; Freetown. (Crtg. M-171/173 CD).	22/10
16/10	Orient Express (V-102)	Transworld	Monrovia; Lome; Lagos; Douala; Tema; Takordi; Abidjan; San Pedro. (Carting at CFS Cotton Avenue).	19/10
18/10	Integra (V-12)	Arebee	Lagos/Apapa; P. Harcourt; Abidjan; Tema; Takoradi; Monrovia; Lome; Freetown; Cotonou; Douala; Matadi. (Carting at M-Jetha C.D.).	21/10
16/10	Supanya	U.L.A./	Lagos/Apapa; Abidjan; Lome/Matadi. (Carting at M-171/173 C.D.).	21/10
		Trident	Tema/Lome; Lagos; Matadi; Lobito; Luanda; Freetown; Cotonou; Douala; P. Harcourt; Abidjan; Monrovia; Dakar. (Crtg. at 7-W/H-PD).	
19/10	Maersk Clementine	V. Fleming	Lagos/Apapa; Dakar; Freetown; Monrovia; Lome; Cotonou; Douala; Tema. (Carting at M.O.D. No. 2).	23/10
21/10	Aries	Seaspeed	West African Ports. (Carting at Hay Bunder No. 5).	26/10

VESSELS DUE IN BOMBAY FOR IMPORT DISCHARGE

Due Date	Steamer's Name	Agents	From
18/10	Albar Harmony	K. Steamship	Japan
18/10	Hoegh Clipper	Patvolk	U.S.A.
20/10	Ind. Explorer (II Call)	I.S.S. Co.	U.K. Cont.
25/10	Jordan I	S.C.I.	U.K. Cont.
18/10	Jala Yamini	S.C.I.	U.S./Canada
18/10	Medipas Sun	Hindustan/L. Triest	Med. Ports.
19/10	Vishva Karuna	S.C.I.	Constanza
26/10	Vishva Madhuri	S.C.I.	U.K. Cont.

MARKET INFORMATION

PEG shortage hits market

Prices of polyethylene glycol (PEG 400) rose slightly by Rs. 3 in the wake of poor availability.

Zinc oxide rose by Rs. 6 to Rs. 58 per kg in the wake of sustained demand. Intermediates continued to be in short supply and trading was moderate. Export activity continued to be satisfactory.

We cannot guarantee the accuracy of the prices published in CHEMICAL WEEKLY as they are based only on the enquiries made by our correspondent – and, as such they are not FIRM PRICES as between a buyer and seller. The prices are published only with a view to giving some ideas of the market conditions.

The prices are inclusive of Excise and Maharashtra Sales Tax.

(Prices as on October 9, 1989)

INDUSTRIAL CHEMICALS	Per Kg.
Ammonium sulphate	2.50
Ammonium phosphate (Mono)	14.50
Ammonium phosphate (Di)	14.00
Ammonium carbonate (Di)	17.00
Ammonium bicarbonate	5.60
Ammonium chloride	3.00
Ammonium nitrate	6.00
Arsenic white powder	22.00
Acrylamide (Resale)	74.00
Barium carbonate	6.00
Bleaching powder (33% Cl)	4.20
Borax (Granular)	15.00
Borax (Powder)	15.25
Boric acid (Tech)	28.00
Bisphenol-A	82.00
Butyl carbitol	110.00
Caustic soda (Flakes)	12.50
Caustic soda (Solid)	12.00
Caustic soda (Lye)	10.00
Calcium chloride 70% (Solid)	3.25
Calcium chloride 75-80%(fused)	3.50
Calcium chloride 36% (Anhydrous)	5.00
Calcium carbonate (precipitated)	4.25
Calcium carbonate (Activated)	4.75
Cobalt oxide	280.00
Cresylic acid	52.00
Camphor (Indian)	105.00
Cream of Tartar (Tech.) China	70.00
Citric acid (Belgium) (Resale)	47.00
Citric acid (Indian) (Resale)	47.00
Copper sulphate	24.00
Chromic acid	63.00
Ethylene urea	58.00
Ferric chloride (Lumps)	5.50
Ferric chloride (Anhydrous)	16.00
Glue flakes	15.00
Glue sheets	6.75
Gohsenol GH-17	112.00
Hydro	44+ST

Hyflosupercell	21.00
Hexamine (Resale)	35.00
Industrial Wax	25.00
Litharge	40.00
Lead Acetate (Tech.)	31.25
Lithopone	25.00
Magnesium chloride (Crystal)	3.00
Menthol crystal (Flakes)	900+Ex+ST
Menthol bold	665+Ex+ST
Menthol crystal cold	700+Ex+ST
Magnesium carbonate (Japan)	16.00
Magnesium carbonate (Indian)	18.00
Maleic Anhydride (Resale)	40.00
Mercury (34.5 Kgs)	12,000.00
Nickel chloride	110.00
Oxalic acid (Resale)	22.00
Peppermint oil (Rectified)	195+Ex+ST
Potassium carbonate (Indian)	34.00
Potassium carbonate (Imported)	33.00
Potassium bichromate	32.50+ST
Potassium phosphate (Mono)	14.00
Potassium phosphate (Di)	14.00
Polyvinyl alcohol (No. 117)	115.00
Polyvinyl alcohol (No. 173)	120.00
Polyvinyl alcohol (No. 208)	150.00
Paraformaldehyde (Resale)	26+ST
Phthalic anhydride 36% (Resale)	25.50
Pentaerythritol (Resale)	45.00
Paraffin wax	20+ST
Rangolite (German)	90+ST
Rangolite (Czech.)	80+ST
Sodium sulphate (Fine)	6.00
Sodium sulphate (Coarse)	5.00
Sodium sulphide 50-52% (Flakes)	11+ST
Sodium sulphide 58-60% (Flakes) (TCL)	20.00
Sodium sulphide pure (Flakes)	12.25
Sodium nitrite (Resale) per 50 kg.	680.00
Sodium chlorite 80% (Spain)	88.00
Soda Ash (Tata)	5.00
Soda Ash (Birla)	4.50
Soda Ash (Imp.)	4.50
Sodium bicarbonate	7.50
Sodium bisulphite	4.50
Sodium silicate	3.00
Sodium acetate	5.00
Sodium alginate	250+ST
Titanium Dioxide (Anatase)	110+ST
Titanium Dioxide (Rutile – RCR_2)	150.00
Tartaric acid	100.00
Trisodium phosphate	5.50
Thiourea	80+ST
Urea (Tech.)	2.90
Vacuum salt	1.00
Zinc Dust	32.00
Zinc Oxide	58.00
Zinc chloride powder (Tech.)	12.50
Zinc sulphate	7.00

SOLVENTS	Per Kg.
Acetic Acid Glacial (Resale)	14.00
Acetic Anhydride (Resale)	31.50
Acetone (Resale)	20.50
Adipic Acid	70.00
Aceto Acetanilide	55.00
Aniline Oil	70.00
Benzoate Plasticiser	62.00
Butyl acrylate	78+ST
Butyl stearate	50.00
Butanol	35+ST
Benzyl Alcohol	60.00
Benzyl Chloride	34.00
Benzo trichloride	16.00
Benzoyl chloride	22.00
Bromine Liquid	78.00
Chloroform	31.00
Carbon Tetrachloride	20.00
Cellosolve	60.00
Cyclohexanone	56+ST
Cyclohexanol	58+ST
Diacetone (Resale)	34.00
Diethyl Oxalate	34.00
Diethyl glycol (DEG)	43.00
Dioctyl Phthalate	45.00
Diallyl Phthalate	56.00
Dimethyl Phthalate	28.00
Dioctyl Adipate	52.00
Dibutyl Adipate	42.00
Dipentene	15.00
Dimethylamine 40%	26.00
Dimethylamine 50%	30.00
Ethyl Acetate	25.00
Ethyl Acrylate	65.00
Ethylene Dichloride	14.50
Ethylene Glycol	45+ST
Formic Acid (Imp.)	24.00
Formaldehyde (Resale)	7.50
Glycerine (CP)	55.00
Glycerine (IW)	53.00
Hydrogen Peroxide 50% (Resale)	26.50
Isopropyl Alcohol	39.00
Isobutyl Alcohol (Resale)	30.00
Monoethanolamine (Resale)	65.00
Melamine	65.00
Methyl Ethyl Ketone	35+ST
Methyl Isobutyl Ketone	58.00
Methyl Acrylate	60.00
Methyl Dichloride (Resale)	26.00

Carbitol	68+ST
Meta Cresol	45.00
Nitrobenzene	30.50
Nitric Acid (Conc.) (RCF)	2.50
Ortho Cresol	30+ST
Phenol (Resale)	38.00
Propylene Glycol	55.00
Polyethylene Glycol (No.200)	58.00
Polyethylene Glycol (No.400)	75.00
Polyethylene Glycol (No.500)	52.00
Polyethylene Glycol (No.1600)	54.00
Polyethylene Glycol (No.4000)	70.00
Polyethylene Glycol (No.6000)	85.00
Para Cresol	110.00
Styrene Monomer	35+ST
Sorbitol	14.00
Sulphuric Acid	2.80
Trichloroethylene	29.00
Triethanolamine (Resale)	65.00
Turpentine Oil (Germany)	8.00
Turkey Red Oil (50%)	20.00
Vinyl Acetate Monomer	47.50

SOLVENTS	Per Litre
Benzene	10.80
N-Heptane	10.50
N-Hexane	12.00
Methanol	10.00
Solvent Naphtha Heavy	10.50
Solvent Naphtha Light	8.50
Toluene	18.00
Xylene	20.00

DYES INTERMEDIATES (PRICES ARE WITHOUT TAX AND EXCISE)

Alphanaphthylamine	63.00
Alpha Naphthol (Imp.)	185.00
Aceto Acetic Ester (Methyl)	66.00
Ammonium Molybdate	220.00
Anthraquinone	125.00
Anthranilic Acid	80.00
2-Amino 4-Nitrophenol	145.00
Blue B. Base (Local)	260.00
Beta Naphthol (Atul)	75.00
Benzidine Dihydrochloride (BDH)	98.00
Bromamine Acid	620.00
BON Acid	130+Ex+Ta
Chicago Acid (Atul)	380.00
Coach Acid	58.00
C. Acid (Imp.)	220.00
Cyanuric Chloride	130.00
2,4- DNCB	30.00
Dihydrothio PTOS (Imp.)	1,000.00
Dimethyl Aniline	71.00
Diethyl Aniline	180.00
Diamino stilbene disulphonic acid	165.00
3,3-DCB (Imp.)	180.00
Gamma Acid (Atul)	200.00
H. Acid (Atul)	130.00
G. Salt	79.00
Isophthalic Acid	45.00
J. Acid	365.00
J. Acid Urea	415.00
K. Acid	125.00
MPDS (German)	200.00
MNA	155.00
Meta Ureido Aniline	235.00
MPD (Local)	215.00
MPD (Japan)	240.00
Naphthenic Acid	40.00
N-Methyl J. Acid	600.00
N-Methyl Aniline	150.00
Naphthalene (Refined)	20.00
Ortho Anisidine (OA) (Imp.)	110.00
Ortho Dichloro Benzene (ODCB)	16.50
OT Base	130.00
Para Dichloro Benzene (PDCB)	30.00
Para Anisidine (PA local)	155.00
PNA	118.00
Para Cresidine (Imp.)	400.00
Para Amino Azo Benzene (India)	190.00
PNCB	60.00
Para Amino Acetanilide	200.00
1-Phenyl 3-Methyl 5-Pyrazolone	170.00
Phenyl J. Acid	365.00
Para Amino Benzoic Acid	135.00
PT Base	155.00
Rhoduline Acid	550.00
Resist Salt 80%	28.00
Resorcinol	210.00
Sodium Naphthionate	67.00
5-Sulpho-Anthranilic Acid	82.00
Sulphanilic Acid	50.00
Sulpho Tobias Acid	170.00
Trichloro Benzene (TCB)	22.00
Tobias Acid	165.00
Metanilic Acid	42.00
MTD	120.00

Bombay Dyes Market

(Prices as on October 9, 1989)

ACID COLOURS	Per Kg.
Acid Violet 4BS	*190.00
Acid Maroon V	110.00
Acid Orange II	112.55
Acid Orange IIY	93.85
Acid Red A	137.00
Acid Scarlet 3R	128.35
Acid Red 3BN	*195.00
Acid Red R2R	132.00
Acid Red RS	88.00
Acid Patent Blue AS	*280.00
Acid Green V	*375.00
Acid Coomasi Blue	200.00
Acid Yellow 5GN	65.00
Acid Red PG	85.00
Acid Red GRS	78.00
Acid Black 10 BX	157.15
Acid Black BX	126.95
Acid Black Wax	135.50
Crosein Scarlet MOO	200.30
Procinil Yellow GS (ICI, UK)	265.00
Procinil Red GS (ICI, UK)	530.00
Procinil Blue RS (ICI, UK)	315.00
Procinil Scarlet G (ICI, UK)	600.00
Procinil Orange G (ICI, UK)	250.00
Procinil Rubine (ICI, UK)	550.00

* To get resale price add 6% tax

DIRECT COLOURS	Per Kg.
Yellow 3GX	114.00
Gun Yellow RCH	175.85
Fast Yellow GCH	171.50
Yellow CFG Hly. Conc.	721.00
Fast Yellow GS	126.96
Fast Yellow CHRS	116.85
Viscose Orange A	210.35
Fast Orange GR	171.50
Red	122.65
Dark Tan	98.15
Red IIR	98.15
Red 4B	217.55
Bordeaux BW	170.10
Fast Scarlet 4BS	223.50
Red [illegible]	220.45
Bordeaux Hly. Conc	249.20
Cotton Red N	117.05
Brill. Fast Helio B	362.85
Brill. Fast Helio 2R	385.85
Brill. Fast Helio 2RS	177.30
Brill. Fast Helio BS	116.10
Brill. Violet Extra	181.45
Blue 2B	102.50
Blue G	220.45
Sky Blue FB	242.00
Copper Blue GR	190.25
Fast Greenish Blue GL	114.60
Developed Black BT	149.95
Blue NB-2B	348.45
Blue NB-2BG	214.70
Developed Black NB-GHB	214.70
Green B	142.75
Green NB-B	218.90
Green 2B-N	218.90
Brown MR	197.40
Brown CN	137.00
Golden Brown G	175.85
Catechin G	155.70
Omega Tan	161.45
Catechin GS	102.80
Black E Hly. Conc.	180.15
Black E Extra Hly. Conc.	180.15
Black NB-ER Hly. Conc.	290.50

DISPERSOL COLOURS	Per Kg.
Red B 3B Conc	611.50
Red B 2B Conc	797.90
Red CB Powder	1048.25
Red D2B Powder	589.85
Violet C 4R Conc.	1202.70
Blue BG Conc	580.65
Blue BN Powder	128.20
Blue D 2R Powder	588 25
Navy BT Conc	531 95
Blue B 2G Conc	577 95
Black BT Conc	319 50
Blue BR	482 40
Yellow 7GL	813 20
Yellow 5RX	269 90
Yellow 3G	473 20
Yellow [illegible]	140 00
Yellow AL	167 20
Yellow Brown REL	311 70
Yellow FFL	571 40
Gold Yellow GG	320 80
[illegible] REL	593 00
Red REL	[illegible]
Red 2B	422 40
Red FB	425 80
Red Violet FBL	622 00
Orange 3R	254.20
Violet 3R	370 50
Violet RL	355 70
Violet 6R	638 20
Scarlet RR	283.50
Rubine 3B	289 10
Rubine CB	449.50
Blue GL	419.00
Blue BGF	805.80
Navy Blue RE	359 90
Brown 3REL	272 80
Black GEL	420.10
Dark Brown 3B	411 10

BASE COLOURS	Per Kg.
Fast Yellow GC	77 75
Fast Orange GC	128 40
Fast Scarlet R	198 05
Fast Scarlet RC	128 40
Fast Scarlét RCR	105 60
Fast Scarlet G	115 75
Fast Scarlet GN	92 95
Fast Scarlet GG	77 75
Fast Scarlet GGS	73 95
Fast Red B	233 50
Fast Red RC	115 75
Fast Red R Flakes	158 80
Fast Red TR	181 50
Fast Red TR Oil	223 35
Fast Red RL	251 20
Fast Red KB Oil	251 20
Fast Bordeaux GP	236 00
Fast Garnet GBC	103 05
Fast Violet B	548 80
Fast Blue BB	[illegible]

NAPHTHOL COLOURS	Per Kg.
ASG	301 85
AS	205 65
ASSW	[illegible]
ASBS	[illegible]
ASBO	[illegible]
ASD	[illegible]
ASOL	[illegible]

ASTR	369.00
ASPH	336.05
ASE	236.00
ASEL	249.95
ASLB	2002.35
ASBT	2459.45
ASWG	143.00
ASSG	538.65
ASSR	652.60

PROCION COLOURS	Per Kg.
Golden Yellow HR	207.95
Brill. Yellow H4G	145.65
Supra Yellow H-8GP	168.55
Brill. Yellow HE6G	214.75
Yellow G-E4R	276.05
Brill. Yellow H7G	332.30
Yellow M4R	275.45
Yellow MGR	387.65
Brill. Yellow M4G	201.15
Brill. Yellow M8G	366.10
Yellow M3R	244.70
Brill. Orange H2R	303.80
Brill. Red H7B	157.95
Brill. Orange M2R	313.15
Brill. Red H8B	213.55
Brill. Scarlet H RN	245.05
Supra Red H-3BP	179.80
Brill. Red H-F3B	243.45
Brill. Magenta HB	182.00
Brill. Red M 5B	160.05
Brill. Red M 8B	218.35
Brill. Pink MB	137.10
Brill. Magenta MB	163.65
Brill. Purple H-3R	219.55
Brill. Purple H-7R	175.40
Navy Blue H 3R	333.75
Brill. Blue H-GR	406.40
Brill. Blue H5G	207.95
Blue H 5RX	286.20
Brill. Blue H 7G	213.95
Brill. Blue H 7RX	358.15
Turquoise HA	265.05
Supra Blue H-3RP	595.30
Supra Turquoise H 2G P	181.50
Blue H-FRD	305.80
Navy Blue H3R	333.75
Blue H 5RX	286.20
Navy Blue M3R	355.70
Brill. Blue MR	405.60
Brill. Blue M RX	214.20
Brill. Blue M-G	226.45
Blue M 4GD	369.40
Navy Blue M RB	341.85
Turquoise M-G	240.30
Brill. Blue M GX	516.25
Blue 3R Acra Powder	718.20
Dark Brown H 6R	248.45
Cobalt Oxide	285.00
Green H4BD	287.00
Green H-E4BI	169.80
Red Brown H IF	143.25
Orange Brown H 28	209.05
Brown M GRN	188.80
Black H-N	314.20

SULPHUR COLOURS	Per Kg.
Navy Blue	210.35
Green G	194.55
Black Grains Extra	72.25
Black Grains OG	73.70
Black GXE Conc.	70.85
Black GXE	57.90
Black GXR	69.40
Black Grains 800	62.80
Black EXR Grains	73.70
Black EXR Grains 800	59.35

VAT COLOURS (ICI)	Per Kg.
Yellow 5G Supra Disperse	561.85
Yellow 5G Acra Conc	818.60
Gold Orange 3G Pdr. Fine	1158.45
Brill. Orange 6R Pdr. Fine	624.35
Gold Orange 3G Supra Disp	693.85
Brill. Orange 6RX Powder	394.30
Brill. Red 3B Pdr. Fine	1214.15
Brill. Red 3B Supra Disp	867.45
Brill. Purple 3R Acra Powder	[illegible]
Brill. Purple 2R Hly Conc.	744.25
Brill. Purple 4R Supra Disp.	604.25
Brill. Purple 2R Acra Conc.	779.85
Blue 2R Powder Fine	675.30
Blue BC Acra Con Pdr. Fine	1013.15
Blue BC Conc. Pdr. Fine	713.65
Blue R Conc. Pdr. Fine	719.70
Blue Conc. Powder	645.80
Brill. Blue 2R Hly. Conc.	378.55
Blue RR Supra Powder	629.35
Brill. Blue 2R Supra Disp.	115.65
Dark Blue 2R Powder Fine	512.65
Blue BC Supra Disp.	419.65
Jade Green XBN Powder Fine	555.80
Jade Green XBN Acra Conc. Pdr	1026.05
Jade Green 2G Pdr. Fine	533.25
Jade Green 2G Ptg. Paste	125.40
Jade Green XBN Ptg. Paste	126.00
Jade Green 2G Supra Disp.	618.00
Olive D Pdr. Fine	563.90
Olive Green B Supra Disp.	421.70
Jade Green XBN Supra Disp. (N)	327.30
Olive OMW Powder Fine	698.55
Olive OMW Supra Disp.	538.05
Olive D Supra Disp.	361.70
Olive R Supra Disp.	470.25
Olive D. Ptg. Paste	193.00
Olive Green B Ptg. Paste	199.10
Olive Green B Acra Conc.	741.10
Olive R Acra Conc.	779.85
Brown R Pdr. Fine	869.45
Dark Brown 3R Fine	826.25
Brown G Supra Disp.	582.05
Brown 2G Supra Disp.	716.10
Brown R Supra Disp	547.35
Brown BR Powder	867.75
Dark Brown 3R Ptg. Paste	217.15
Dark Brown 3R Supra Disp	529.60
Brown G Acra Conc.	967.95
Brown M. Powder Fine	768.80
Grey M. Supra Disp.	585.45
Blue BC Acra Conc. Pdr. Fine	762.70
Direct Black AC Supra Disp.	415.75
Direct Black AC Pdr. Fine	574.70
Direct Black CH Supra Disp.	490.45
Direct ACD Ptg. Paste	217.15

Delhi Market

DELHI: OCT. 6, (NNS) Titanium dioxide jumped up sharply by Rs. 13 at Rs. 122 per kg in the local chemicals market during the week under review, on account of good demand from plastic and paint units as well as restricted inflow from Kerala, says NNS. K. brand titanium dioxide also rose from Rs. 100 to Rs. 103 per kg.

As a result of negligible stock position in the market as well as fall in import from Germany, rangolite Germany flared up by Rs. 5 at Rs. 105 per kg. Demand was good by gur khandsari makers. Sufolite moved up by Rs. 2 at Rs. 81 and chatkolite appreciated by Re. 1 at Rs. 80 per kg due to poor supply.

Borax crystal and granular hardened by Rs. 50 at Rs. 750 each per 50 kg caused by hike in its prices by company. Sodium sulphate red marka looked up by Rs. 100 at Rs. 3,900 per tonne owing to dwindling supply, while black marka sodium sulphate ruled quiet at its last week's level of Rs. 3,600. Gwalior Rayon sodium sulphate was quoted at Rs. 3,300. Mercury suffered a fall of Rs. 100 at Rs. 11,100 per flask thanks to increased arrivals and lower advices from Bombay. In Bombay, mercury drifted lower at Rs. 10,800.

Menthol medium and bold moved up by Rs. 5/10 at Rs. 345 and Rs. 370 and menthol flake also rose from Rs. 315 to Rs. 317 per kg in the beginning of the week owing to fall in arrivals from U.P. and increased demand by stockists, but at the weekend, in the wake of poor speculative demand and pressure of arrivals from Sambhal, Moradabad, Amroha and Chandausi areas of U.P. prices of menthol medium, bold and flake dropped sharply by Rs. 20/25 at Rs. 320, Rs. 350 and Rs. 295 per kg respectively. Diwali delivery menthol flake was transacted at Rs. 310 against Rs. 330. DMO and mentha oil eased by Rs. 5/15 at Rs. 110 and Rs. 210/230 per kg.

Slack wax nose-dived from Rs. 10,300 to Rs. 9,500 per tonne due to slack offtake. Paraffin wax slumped by Rs. 20 at Rs. 860 per 50 kg on withdrawal of support. No variation was recorded in dyes and colours in thin trading.

(DELHI MARKET RATES AS ON OCTOBER 6, 1989)

Ammonia Bicarb (Per 25 Kg.)	150.00
Mercury (Per flask)	11,100.00
Soda ash (Per bag)	335/355.00
Ammonium Chloride (50 Kg.)	110/180.00
Caustic soda flakes (50 Kg.)	565.00
Citric acid (Per 50 Kg.)	2,175/2,475.00
Stable Bleaching Powder Shriram (Per 25 Kg.)	100 00
Stable Bleaching Powder KCI (Per 25 Kg.)	95 00
[illegible] Bleaching Powder [illegible] (Per 25 Kg.)	90.00
[illegible]	[illegible]

Sodium Bicarbonate (50 Kg.)	290/300.00
Sodium Hydrosulphite (Per Kg.)	34.00/37.00
Rangolite (Per Kg.)	80.00/105.00
Boric acid Technical (Per 50 Kg.)	1,500.00
Paraffin Wax (Per 50 Kg.)	860.00
Tartaric Acid (Trishul Per 15 Kg.)	3,250.00
Borax Granular (Per 50 Kg.)	750.00
Borax Crystal (Per 50 Kg.)	750.0C
Sodium Nitrite (Per 50 Kg.)	700/760.00
Sodium Nitrate (Per 50 Kg.)	425.00
Camphor Thal (Per Kg.)	109.00
Camphor Powder (Per Kg.)	100 00
Menthol Bold (Per Kg.)	350 00
[illegible]	320 00

Menthol Flake (Per Kg.)	295.00
Glycerine (Per Kg.)	55/58.00
Sodium Silicate (Per quintal)	275/350.00
Hexamine (Per Kg.)	33.50
Acetic Acid Glacial (Per Kg.)	15.00
Copper Sulphate (Per quintal)	2,400/2,750
Formic Acid (Per Kg.)	25.00
Formaldehyde (Per Kg.)	8.50
Hydrogen Peroxide (Per Kg.)	27/28.00
Calcium Carbonate (Per Tonne)	2,500/4,000
Acid Slurry Soft (Per Kg.)	28.00
Acid Slurry Hard (Per Kg.)	38.00
Phosphoric Acid (Per 50 Kg.)	1,050.00
Potassium Nitrate (Per quintal)	900/1,200.00
Potassium Permanganate (Per 50 Kg.)	2,800/3,200.00
Sodium Bichromate (Per 50 Kg.)	1,575/1,600.00
Trisodium Phosphate (50 Kg.)	550.00
Titanium Dioxide Anatase (Per Kg.)	122.00
Titanium Dioxide RC-822 (Per Kg.)	150.00
Titanium Dioxide K-Brand (Per Kg.)	103.00
Titanium Dioxide RCR-2 (Per Kg.)	150.00
Zinc Oxide (Per metric tonne)	42,000/52,000.00
Phenol Carbolic Acid (Per Kg.)	37.00
Carbon Tetrachloride (Per Kg.)	24.25
Chloroform (Per Kg.)	28.00
Sodium Sulphate (Per metric tonne)	3,300/3,800.00
Naphthalene Balls (Per 50 Kg.)	1,325.00

DYES & COLOURS	(Per Kg.)
Naphthol AS	175/201.65
Naphthol ASG	180/295.20
Naphthol ASBS	210/248.45
Naphthol ASTR	265/360.45
Naphthol ASOL	210/238.60
Naphthol ASBO	195/260.75

DIRECT DYES	(Per Kg.)
Black E. Conc.	110/176.90
Diazo Black B.T.	105/147.55
Green B	90/140 55
Blue 2-B	60/101.40
Blue 2-B 225% (JNR)	125.00
Sky Blue FB	160/235.05
Basic Auramine	55/110 00
Basic Rhodamine	300/425 00
Basic Methylene Blue	100/180 00
Basic Violet	150/180 00
Basic Malachite Green	150/165 00
Acid Orange	75/111 20
Congo Red H.C	75/120.[illegible]

Madras Market

Markets were brisk with good enquiries for chemicals from consuming industries. Items like hydros, caustic soda, sodium sulphide etc. had good business. Paint raw materials also received good enquiries and business done. In the solvent section acetone was under short supply and prices ruled at Rs. 22.50 per kg. NOCIL had announced increase in the prices of solvents like PA, MIBK, PEG, DEG etc. but the price increases had very little impact, as the prices of these items are already ruling above normal due to non-availability. In fact prices of MIBK dropped by Rs. 3 per kg from previous levels and DEG also registered a fall due to reported arrivals of imported material. Ethyl acetate prices were up by Rs. 3 per kg due to reported shortage of alcohol to consuming industries in the northern part of the country.

(MADRAS MARKET RATES AS ON OCTOBER 7, 1989)

Acetic Acid Glacial (per kg)	16.50
Aluminium Sulphate Iron free (per MT)	4,000.00
Ammonium Bicarbonate (per 25 kgs)	130.00
Ammonium Chloride (per MT)	3,000.00
Acid Slurry (per kg)	30.00
Barium Carbonate (per kg)	6.00
Barium Chloride (per kg)	5.50
Boric Acid Technical (per kg)	24.00
Bleaching Powder (per 50 kgs)	220.00
Borax (per 50 kgs)	685.00
Caustic Soda Flakes -- Mettur Chemicals (per MT)	11,800.00
Caustic Soda Flakes -- Andhra Sugars (per MT)	11,800.00
Calcium Chloride 70% Solid (per MT)	3,000.00
Calcium Chloride Anhydrous (per MT)	5,750.00
Calcium Carbonate (Activated) (per MT)	5,750.00
Calcium Carbonate (Precipitated) (per MT)	4,750.00
Citric Acid (per kg)	48.00
Copper Sulphate (per kg)	24.00
Cresylic Acid 98-99% (per kg)	130.00
Pure Para Cresol 96% (per kg)	78.00
Meta Para Cresol 42% (per kg)	49.50
Formic Acid (per kg)	26.00
Formaldehyde (per kg)	8.00
Glue Flakes (per kg)	15.00
Glycerine (per kg)	47.50
Hydrosulphite of Soda (TCPL) (per kg)	38.00
Hydrosulphite of Soda (IDI) (per kg)	42.00
Hydrosulphite of Soda (BASF) (per kg)	42.00
Hexamine (per kg)	29.00
Hyflo Supercell (per kg)	20.00
Hydrogen Peroxide (per kg)	29.50
Litharge (per kg)	40.00
Lead Acetate (per kg)	42.00
Magnesium Carbonate (per kg)	19.50
Magnesium Chloride (per kg)	3.00
Maleic Anhydride (per kg)	40.00
Menthol Crystals (per kg)	380.00
Oxalic Acid (per kg)	24.00
Paraffin Wax (per kg)	18.00
Potassium Bichromate (per kg)	36.00
Phosphoric Acid (per kg)	24.00
Polyvinyl Alcohol Powder (per kg)	130.00
Pentaerythritol (per kg)	52.00
Phthalic Anhydride (per kg)	30.00
Soda Ash (TAC) (per 75 kgs)	385.00
Soda Ash (TATA) (per 75 kgs)	385.00
Sodium Bicarbonate (TATA) (per 50 kgs)	375.00
Sodium Silicate (per MT)	3,500.00
Sodium Bichromate (per kg)	28.00
Sodium Nitrate (per kg)	8.00
Sodium Nitrite (per kg)	15.00
Sodium Sulphide Flakes (per kg)	12.00
Sodium Bisulphite (per kg)	4.50
Sodium Alginate (per kg)	225.00
Sodium Acetate (per kg)	7.00
Sodium Sulphate (Anhydrous) (per kg)	3.00
Titanium Dioxide (Anatase) (per kg)	105.00
Titanium Dioxide (Rutile) (per kg)	125.00
Trisodium Phosphate (per kg)	7.00
Urea (Technical) (per kg)	3.00
Zinc Oxide (per kg)	54.00
Zinc Chloride Powder (per kg)	12.00
Zinc Sulphate (per kg)	6.50

SOLVENTS

Acetone -- HOCL (per kg)	22.50
Butanol (per kg)	36.00
Butyl Acetate (per kg)	44.00
Benzene (per lit)	17.00
Cellosolve (per kg)	50.00
Carbon Tetra Chloride (per kg)	23.00
Chloroform (per kg)	28.00
Diacetone Alcohol (per kg)	30.00
Diethylene Glycol (per kg)	48.00
Dichloroethane (per kg)	17.00
Di-octyl Phthalate (per kg)	46.00
Di-N-butyl Phthalate (per kg)	48.00
Ethyl Acetate (per kg)	23.00
Isopropyl Alcohol (per kg)	38.00
Methanol (per kg)	10.00
Methylene Chloride (per kg)	23.50
Methyl Ethyl Ketone (per kg)	39.00
Methyl Isobutyl Ketone (per kg)	52.00
Phenol (per kg)	38.00
Sorbitol (per kg)	15.00
Triethanolamine (per kg)	60.00
Trichloroethylene (per kg)	25.50
1-1-1 Trichloroethane (per kg)	27.00
Turpentine (per lit)	16.50
Toluene (per lit)	18.00
Xylene (per lit)	22.00

Materials Imported

BOMBAY
(From 1.6.89 to 7.6.89)
(Contd. from previous issue)

DIMETHYL CARBAMOYL CHLORIDE: From FRG: S.S. Pharmachem, 950 Kgs., Rs. 69,775.

DIETHYL KETONE: From USA: Camphor & Allied Products Ltd., 168 Kgs., Rs. 11,645.

1-DI-2-HYDROXY ETHYL AMINO 3-PROPIONYL AMINO BENZOL: From Switzerland: Sandoz India Ltd., 2,542.800Kgs., Rs. 8,20,582.

DIISOPROPYLAMINE: From FRG: S.D Fine Chem Pvt. Ltd., 15,000 Kgs., Rs. 74,035.

1-DIMETHYL AMINO 2-CHLOROPHOSPHANE HCL: From UK: May & Baker Ltd., 1,375 Kgs., Rs. 1,96,891.

DIMETHYL DICHLORO SILANE: From FRG: Cadila Laboratories Ltd., 3,000 Kgs., Rs. 1,13,321.

DIMETHYL SULFOXIDE: From USA: German Remedies Ltd., 3,000 Kgs., Rs. 2,73,237.

DIMETHYLAMINE: From Italy: Gharda Chemicals Ltd., 25.740 MTs., Rs. 4,13,147.

2,4 DINITRO TOLUENE: From FRG: Atul Products Ltd., 6,500 Kgs., Rs. 2,50,983.

DIPHENYLAMINE CHIPS: From UK: Atul Products Limited, 1,500 Kgs., Rs. 70,812.

DIPHENYL GUANIDINE: From FRG: Bayer India Ltd., 3,600 Kgs., Rs. 2,54,924.

DIPHENYLMETHANE- 4,4 DIISOCYANATE: From USA: Godrej & Boyce Mfg. Co. Ltd., 57,000 Kgs., Rs. 17,40,092.

EPICHLOROHYDRIN: From USA: Dr. Beck & Co. Ltd., 49,041 Kgs., Rs. 13,00,349; Hindustan Ciba Geigy Ltd., 16,347 Kgs., Rs. 4,39,881.

ETHOXY ETHYLENE MALONIC ACID ESTER: From FRG: Sharvani Pharmaceuticals Ltd., 3,000 Kgs., Rs. 6,13,706.

ETHOXY METHYLENE DIETHYL MALONATE: From FRG: Bayer (India) Ltd., 3,400 Kgs., Rs. 6,95,533.

2-ETHYL AMINO PARACRESOL: From FRG: Associated Dyechem Pvt. Ltd., 1,019 Kgs., Rs. 2,99,375.

N-ETHYL ANILINE: From Switzerland: Amar Dye Chem Ltd., 1,000 Kgs., Rs. 69,239.

ETHYL CYANO ACETATE: From USA: Atul Products Limited, 2,250 Lbs., Rs. 2,32,197.

ETHYL GLYCOL: From USA: Goodlass Nerolac Paints Ltd., 18,000 Kgs., Rs. 3,69,869.

2-ETHYL HEXANOIC ACID: From Japan: Abdulla Bhai Abdul Kadar, 14,400 Kgs., Rs. 2,32,197.

ETHYL HEXYL ACRYLATE: From Japan: Sanghi Leathers Pvt. Ltd., Rs. 13,600 Kgs., Ts. 4,02,339.

ETHYL MERCAPTAN: From Belgium: Bharat Petroleum Corpn. Ltd., 4,320 Kgs., Rs. 1,18,861.

2-ETHYL THIOETHANOL: From FRG: Cadila Laboratories Ltd., 1,000 Kgs., Rs. 37,766.

GAMMA PICOLINE 98%: From Japan: Chemo Pharma Laboratories Ltd., 15,200 Kgs., Rs. 7,31,914.

GLYOXYLIC ACID 50%: From France: E. Merck India Ltd., 500 Kgs., Rs. 41,805.

HELIUM LIQUID: From USA: Industrial Oxygen Co. Ltd., 37,170 Ltrs., Rs. 21,47,985.

HYDRAZINE HYDRATE 80%: From USA: Zenith Ltd., 58 MTs., Rs. 16,75,887.

HYDROFLUORIC ACID: From USA: Bharat Electronics Ltd., 12,000 Kgs., Rs. 5,57,596.

HYDROGEN CHLORIDE GAS: From UK: Sandvik Asia Ltd., 78 Nos., Rs. 2,17,480.

HYDROGEN PEROXIDE 50%: From France: Southern Sea Foods Pvt. Ltd., 37.400 MTs., Rs. 3,62,328.

HYDROQUINONE: From Japan: PRV Chemicals & Allied Inds., 5,300 Kgs., Rs. 2,54,374.

HYDROXY ETHYL ACRYLATE: From UK: Noble Synthetics, 454 Kgs., Rs. 33,332.

IODINE CRUDE: From Japan: Kirti Chemicals, 6,000 Kgs., Rs. 1,84,867; Multichem Laboratories, 1 MT., Rs. 3,11,573.

IODINE CRUDE 99.5%: From China: G. Amphray Laboratories, 20,000 Kgs., Rs. 59,79,696.

ISO BORNYL ACETATE: From GDR: Dyes Distributors India Ltd., 25 MTs., Rs. 4,28,188.

ISO BUTYL BENZENE: From UK: M.J. Pharm Ltd., 13,680 Kgs., Rs. 7,81,396.

ISOCYANATE: From Netherlands: L M L Ltd., 9,030 MTs., Rs. 2,74,634.

ISOPROPYL ALCOHOL: From Japan: Ruhr Chemicals, 4,075 Kgs., Rs. 51,300.

L-BASE: From China: Dymach Pharma, 2,000 Kgs., Rs. 16,05,074; Parag Pharmaceuticals (I) Pvt. Ltd., 2,000 Kgs., Rs. 16,05,076; Themis Agencies, 1,000 Kgs., Rs. 7,82,081; Umedica Labs. Pvt. Ltd., 1,000 Kgs., Rs. 7,55,330.

L-BASE 99%: From China: Mehta Pharmaceuticals Inds., 1 MT. Rs. 7,67,919.

L-LYSINE MONO HCL: From Japan: Turakhia Brothers, 500 Kgs., Rs. 41,701.

LINALYL ACETATE: From France: Seth Brothers Pvt. Ltd., 600 Kgs., Rs. 90,936.

LITHOPONE 30%: From Czechoslovakia: Abdulabhai Abdul Khader, 20,000 Kgs., Rs. 1,41,050.

MANCOZEB TECH 85%: From Netherlands: Lupin Agro Chemicals Pvt. Ltd., 24,000 Kgs., Rs. 7,89,770.

METHYL CHLOROFORMATE: From Hungary: Qure Drugs Pvt. Ltd., 14,400 Kgs., Rs. 3,05,908.

METHYL HEXAHYDRO PHTHALIC ANHYDRATE: From Japan: Cibatul Ltd., 1,100 Kgs., Rs. 60,584.

MOLYBDENUM TRIOXIDE: From Japan: Sudarshan Chemical Inds., 1,000 Kgs., Rs. 1,14,086.

MONOMETHYL ACETO ACETAMIDE: From FRG: Hindustan Ciba Geigy Ltd., 25,200 Kgs., Rs. 6,82,062.

MORPHOLINE: From FRG: RMP Diamonds, 8,000 Kgs., Rs. 7,68,888.

PARA NITRO CHLORO BENZENE: From FRG: Polyolefins Inds. Ltd., 18.320 MTs., Rs. 5,07,473.

NOVALDIAMINE: From FRG: IPCA Laboratories Pvt. Ltd., 5,610 Kgs., Rs. 18,25,240.

OCTOIC ACID: From FRG: ALA Chemicals Ltd., 5,040 Kgs., Rs. 95,189; From Japan: Aman Enterprises, 7,200 Kgs., Rs. 1,15,238; Technoaid Products, 7,200 Kgs., Rs. 1,15,238.

PARA OCTYL PHENOL: From Japan: Indian Plastics Ltd., 6,000 Kgs., Rs. 1,51,066.

PARAFORMALDEHYDE: From Spain: Chemo India, 24,000 MTs., Rs. 2,07,716.

PARAFORMALDEHYDE 96%

PRILLS: From Spain: Goodlass Nerolac Paints Ltd., 16,000 Kgs., Rs. 1,56,101.

PERCHLORO ETHYLENE: From FRG: Anshul Chemicals Pvt. Ltd., 18,760 Kgs., Rs. 1,66,793; Prohbex's Aids, 19,825 Kgs., Rs. 1,82,501.

D(-)ALPHA PHENYL GLYCINE CHLORIDE HCL: From Netherlands: Lupin Laboratories Ltd., 5,775 Kgs., Rs. 19,77,775; From Spain: Ranbaxy Laboratories Ltd., 6,440 Kgs., Rs. 21,67,162.

PHENYL XYLYL ETHANE: From Japan: Hind Condensor Ltd., 4,000 Kgs., Rs. 1,25,888.

POTASSIUM CARBONATE GRANULAR 99%: From Japan: G. Amphray Laboratories, 17,000 Kgs., Rs. 1,73,490.

POTASSIUM FERROCYANIDE: From FRG: Hitesh Chemicals, 6,000 Kgs., Rs. 1,15,188; Jadavji & Co., 6,000 Kgs., Rs. 1,15,185; Shreejee Enterprises, 6,000 Kgs., 1,15,188.

PROPIONIC ANHYDRIDE: From USA: Alembic Chemical Works Co. Ltd., 3,130 Kgs., Rs. 1,37,910.

PROPYLENE GLYCOL USP: From USA: Rallis India Ltd., 8.385 MT., Rs. 1,64,933.

SILICA PRECIPITATED: From FRG: Modi Rubber Ltd., 27,500 Kgs., Rs. 4,19,285.

SILICON CARBIDE : From Norway: Flexoplast Abrasives India Ltd., 2,500 Kgs., Rs. 1,09,681.

SODIUM 2 ETHYL HEXANOATE: From UK: Ranbaxy Laboratories Ltd., 1,000 Kgs., Rs. 64,878.

SODIUM O PHENYL PHENOLATE: From FRG: Shree Vinayak Organics Pvt. Ltd., 200 Kgs., Rs. 25,014.

SODIUM STYRENE SULPHONE SULPHONATE: From Japan: IPCL., 4,000 Kgs., Rs. 6,58,709.

SOYA LECITHIN: From Canada: Anchemco Limited, 2,04,119 Kgs., Rs. 5,394.

TERPINEOL: From France: Chimanlal Mangalal & Co., 12,000 Kgs., Rs. 3,57,780.

THEOPHYLLINE ANHYDROUS BP 80: From China: Pfizer Ltd., 1,000 Kgs., Rs. 2,17,157.

TITANIUM DIOXIDE: From USA: Rainbow Ink & Varnish Mfg. Co. Ltd., 15 MTs., Rs. 5,78,300.

TERTIARY BUTYLAMINE: From Belgium: Lanz Labs., 675 Kgs., Rs. 42,495; S.D. Fine Chem Pvt. Ltd., 270 Kgs., Rs. 16,988; S.D. Pharmaceuticals, 270 Kgs., Rs. 20,398.

PARA TERTIARY BUTYL PHENOL: From Japan: Bakelite Hylam Ltd., 14,000 Kgs., Rs. 3,04,020; Indian Plastics Ltd., 6,000 Kgs., Rs. 1,51,066.

TETRA ETHYLENE GLYCOL DIMETHACRYLATE: From USA: Apuraj Chemicals Pvt. Ltd., 2,400 Lbs., Rs. 1,21,549.

TETRAHYDROFURAN: From FRG: Jai Electronic Inds. Pvt. Ltd., 5,040 Kgs., Rs. 2,44,530.

TOLUENE DI ISOCYANATE: From Japan: Nufoam Industries, 16,000 Kgs., Rs. 5,57,685.

TRICHLORO TRIFLUORO ETHANE: From Japan: Hyderabad Allwyn Ltd., 1,925 Kgs., Rs. 2,14,148.

TRICRESYL PHOSPHATE: From FRG: Hindustan Petroleum Corpn. Ltd., 9,120 Kgs., Rs. 4,31,225.

TRIMETHYL PHOSPHITE: From USA: Khatau Junker Limited, 15,513.48 Kgs., Rs. 5,61,461; Vantech Pesticides Ltd., 15,513.48 Kgs., Rs. 5,61,462.

TRIS-2 (HYDROXY ETHYL) ISOCYANATE: From Japan: Dr. Beck & Co. (I) Ltd., 17,000 Kgs., Rs. 7,21,482.

XYLENOL 50: From Italy: Dr. Beck & Co. Ltd., 93,600 Kgs., Rs. 18,04,294.

PLASTIC MATERIALS IMPORTED BOMBAY (From 1.6.89 to 7.6.89)

HDPE: From Brazil: Bhagwati Polypack & Chemicals Ltd., 30 MTs., Rs. 5,29,165; Gilt Pack Ltd., 90 MTs., Rs. 14,93,539; Kamlex Polytex (P) Ltd., 50 MTs., Rs. 8,68,631; Shamco Plastics Pvt. Ltd., 50 MTs., Rs. 8,57,482; Suvasini Filaments 20 MTs., Rs. 3,54,227; Nipso Polyfabrics Pvt. Ltd., 30 MTs., Rs. 5,27,885; From Czechoslovakia: Associated Plastic Inds., 100 MTs., Rs. 11,46,660; Fibro Plast Corpn., 25 MTs., Rs. 2,84,304; Naresh Traders, 137.5 MTs., Rs. 15,378,701; From Japan: Diamond Polyprints, 16 MTs., Rs. 2,86,474; Popatlal Mavji and Sons, 48,000 Kgs., Rs. 8,61,076; Star Plastics, 32,000 Kgs., Rs. 5,74,050; From Saudi Arabia: Associated Brothers, 51.450 MTs., Rs. 7,77,234; Evershine Plastic Inds., 17,150 MTs., Rs. 2,60,428; Grover Overseas Pvt. Ltd., 17,150 Kgs., Rs. 2,59,078; Kalawati Inds., 17.150 MTs., Rs. 3,02,258; King Plastics, 99 MTs., Rs. 13,92,184; Mukut Plastics Pvt. Ltd., 51.450 MTs., Rs. 8,62,245; New Plastomers India Ltd., 17.150 MTs., Rs. 2,99,559; Plastics Industries, 51.450 MTs., Rs. 8,62,245; Prince Plastics: 123.750 MTs., Rs. 18,40,230; Ravi International, 17,150 Kgs., Rs. 2,99,559; Sachdeva Enterprises, 48.5 MTs., Rs. 7,49,986; From Singapore: Incab Inds. Ltd., 175 MTs., Rs. 2,09,387; From Sweden: Karnataka Telecables Ltd., 32.500 MTs., Rs. 7,72,564; From USA: Shanti Packaging Pvt. Ltd., 52.5 MTs., Rs. 9,08,756; Paharpur Plastics, 162 MTs., Rs. 26,56,033; From Yugoslavia: Fortuna Agencies, 120 MTs., Rs. 19,50,876; Harkeb Holding Pvt. Ltd., 151.450 MTs., Rs. 23,98,917; From Yugoslavia: Manish International, 50 MTs., Rs. 6,15,252; Ravi International, 90,000 Kgs., Rs. 14,64,084.

LDPE: From Japan: Upcom Cables Ltd., 50 MTs., Rs. 19,70,152; From Netherlands: Gyan Packaging Inds. Pvt. Ltd., 15 MTs., Rs. 2,83,249; From Sweden: Universal Cable Ltd., 12 Mts., Rs. 5,64,594.

LLDPE: From Netherlands: Mazda Packaging Ltd., 15 MTs., Rs. 2,89,150.

PVC RESIN: From Argentina: Morewater Pipes Ltd., 400 MTs., Rs. 50,58,832; From Brazil: Dutron Plastics Pvt. Ltd., 100 MTs., Rs. 14,24,111; From FRG: Jyoti Leather Cloth Manufacturers Pvt. Ltd., 15 MTs., Rs. 3,10,623; From Japan: Willard India Ltd., 14 MTs., Rs. 3,09,308; From Korea: Asian Leather Cloth Mfg. Co., 15 MTs., Rs. 3,15,791; From Mexico: Chemicals & Plastics India Ltd., 3,00,000 Kgs., Rs. 55,01,210; From Romania: Kundalia Inds., 450 MTs., Rs. 59,14,021; The Supreme Inds Ltd., 500 MTs., Rs. 65,71,965.

POLYETHYLENE: From Czechoslovakia: Vindhya Telelinks Ltd., 67.5 MTs., Rs. 16,07,874.

POLYPROPYLENE: From Australia: Mohan Overseas Pvt. Ltd., 30,000 Kgs., Rs. 4,65,872; From Belgium: Furn Plastics Inds. Ltd., 75 MTs., Rs. 13,02,691; From Brazil: The Ashok Plastic Industries, 50 Kgs., Rs. 7,15,990; Nithi Plastics Pvt. Ltd., 1,00,000 Kgs., Rs. 14,76,474; Shubham Polymers Limited, 50 MTs., Rs. 7,50,770; From Hungary: Alpha Packaging, 15 MTs., Rs. 2,43,122; Hindustan Exports Enterprises, 59.425 MTs., Rs. 8,45,593; From Singapore: Sunil Polyplast, 15.5 MTs., Rs. 2,63,421; From Spain: Kamath Packaging Pvt. Ltd., 180 MTs., Rs. 25,99,956; Vishal Plastomers Pvt. Ltd., 225 MTs., Rs. 33,74,445; Vishal Plastomers Pvt. Limited, 60 MTs., Rs. 8,99,952; From USA: Dalmia Plastics, 17 MTs., Rs. 2,56,812; Indian Petrochemicals Corpn. Limited, 71.425 MTs., Rs. 15,23,321; Pan Asia International Pvt. Ltd., 8,250 Kgs., Rs. 1,18,594.

POLYSTYRENE: From Brazil:

amnadas Murlidhar Jaisingh, 20 MTs., Rs. 4,24,644.

DRUG MATERIALS IMPORTED BOMBAY (From 1.6.89 to 7.6.89)

D-PANTHENOL USP: From Japan: Medley Pharmaceuticals Pvt. Ltd., 200 Kgs., Rs. 60,969.

L-LYSINE MONO HCL USP: From Japan: NR Jet Pharmaceuticals Ltd., 500 Kgs., Rs. 48,782.

LYSINE HYDROCHLORIDE USP: From Japan: Biological E. Limited, 6,000 Kgs., Rs. 5,52,336.

NIKETHAMIDE BP 80: From Switzerland: Hindustan Ciba Geigy Ltd., 200 Kgs., Rs. 56,039.

MATERIALS IMPORTED BOMBAY (From 8.6.89 to 14.6.89)

ACRYLAMIDE: From Japan: Shri Radhakrishna Dye Chem Pvt. Ltd., 1,020 Kgs., Rs. 25,681.

ACRYLONITRILE: From Austria: Asian Paints India Ltd., 14,800 Kgs., Rs. 2,95,052; Gharda Chemicals Ltd., 14.800 MTs., Rs. 2,98,158; From Taiwan: Ganalax Trading & Finance Pvt. Ltd., 12,800 Kgs., Rs. 2,31,634; Shankarlal & Co., 12,800 Kgs., Rs. 2,31,634.

ADIPIC ACID: From UK: ALA Chemicals Ltd., 36,000 Kgs., Rs. 6,74,132.

ALDEHYDE C-10: From Switzerland: Industrial Perfumes Ltd., 600 Kgs., Rs. 98,556.

ALUMINIUM OXIDE: From USA: Indian Petrochemical Corpn. Ltd., 25.441 MTs., Rs. 7,62,017.

DL-2 AMINO BUTANOL 1: From FRG: Cadila Laboratories Ltd., 10,140 Kgs., Rs. 13,96,782.

2-AMINO NAPHTHALENE 6-SULPHONIC ACID: From Switzerland: Sandoz (India) Ltd., 5,720 Kgs., Rs. 12,28,064.

ANHYDROUS AMMONIA: From Qatar: Rashtriya Chemicals & Fertilizers, 3,150.135 MTs., Rs. 82,45,336.

2-B ACID: From Japan: Indian Dyestuff Inds. Ltd., 4,404.9 Kgs., Rs. 4,64,415.

BISPHENOL LIQUID: From Israel: J. Kirit & Brothers, 11,340 Kgs., Rs. 2,83,730; S.V. Trading and Agencies Ltd., 11,440 Kgs., Rs. 2,87,299; From Netherlands: Gujarat Insecticides Ltd., 34,030 Kgs., Rs. 8,61,898.

BUTACHLOR TECH 90%: From USA: Herbicides India Ltd., 34,920 Lbs., Rs. 7,30,838.

2 BUTENE 1,4 DIOL: From FRG: Bharat Pulverising Mills Ltd., 15,600 Kgs, Rs. 10,69,075.

BUTYL ACRYLATE: From France: Dai Ichi Karkaria Ltd., 14,800 Kgs., Rs. 4,23,866.

N-BUTYL ACRYLATE: From USA: IAC Chemicals Pvt. Ltd., 14.700 MTs., Rs. 4,27,942.

PARA TERTIARY BUTYL PHENOL: From FRG: Coates Of India Ltd., 12,000 Kgs., Rs. 2,53,032.

CAPROLACTAM: From Belgium: LML Fibres Ltd., 497 MTs., Rs. 1,48,59,543.

CATECHOL : From Italy: IDL Chemicals Ltd., 1,000 Kgs., Rs. 81,827.

CINNAMIC ALCOHOL: From USA: Kanta Chemicals, 600 Kgs., Rs. 74,588.

CYANURIC CHLORIDE: From Belgium: Anil Industries, 1,000 Kgs., Rs. 45,328; Eata Bright Process Inds., 1,000 Kgs., Rs. 45,328; Jay Chemical Inds., 1,000 Kgs., Rs. 45,328; Jinu Dyestuff Pvt. Ltd., 1,000 Kgs., Rs. 45,328; Scindia Ceramic & Synthetic, 500 Kgs., Rs. 22,664; Shalimar Dyechem, 1,000 Kgs., Rs. 45,328.

4-CYANOPYRIDINE: From Japan: Mehta Pharmaceutical Inds., 15,000 Kgs., Rs. 10,81,066.

DL METHIONINE: From France:

Lipton India Ltd., 10,000 Kgs., Rs. 4,72,081.

2,6 DIETHYLANILINE: From Switzerland: Hindustan Insecticides Ltd., 14,820 Kgs., Rs. 6,64,643.

DIETHYL CARBONYL CHLORIDE: From FRG: Chemipharm Chem & Pharmaceutical, 1,140 Kgs., Rs. 83,731.

DIETHYLENE DIAMINE: From FRG: Fine Chemicals, 7,600 Kgs., Rs. 2,37,292.

DIETHYLENE TRIAMINE PENTAACETIC ACID: From UK: May & Baker (India) Ltd., 800 Kgs., Rs. 1,02,435.

DIISOBUTYLENE: From FRG: PDI Chemicals Ltd., 2,030 Kgs., Rs. 40,555.

DIMER ACID: From USA: Coates India Ltd., 31,160 Kgs., Rs. 2,69,685.

DIMETHYL AMINE 60% SOLN: From Italy: Gharda Chemicals Ltd., 25.740 MTs., Rs. 4,13,147.

DIMETHYL FORMAMIDE: From France: Rashtriya Chemicals & Fertilisers Ltd., 96 MTs., Rs. 16,91,982.

DIMETHYL SULFOXIDE: From USA: K.Sevantilal and Co., 3,175 Kgs., Rs. 88,122.

DIMETHYL SULPHIDE: From France: Indian Petrochemicals Corpn. Ltd., 2,970 Kgs., Rs. 78,963.

DIMETHYL TRIETHOXY SILANE: From FRG: Dr. Beck & Co. India Ltd., 1,900 Kgs., Rs. 5,50,468.

ETHYL CYANOACETATE: From Japan: Apuraj Chemicals Pvt. Ltd., 1,000 Kgs., Rs. 1,02,284.

ETHYL MERCAPTAN: From Netherlands: Cyanamid India Ltd., 19,050 Kgs., Rs. 4,22,647.

ETHYLENE OXIDE: From UK: Sandoz India Ltd., 19,200 Kgs., Rs. 4,59,241.

HEXAMETHYL DISILAZANE: From FRG: Armour Chemicals Ltd., 5,120 Kgs., Rs. 7,34,919.

HYDROGEN SULPHIDE: From UK: University Of Bombay, 10 Kgs., Rs. 3,244.

HYDROQUINONE: From Japan: New Synth Chem Inds., 17,000 Kgs., Rs. 7,30,990.

8-HYDROXYQUINOLINE: From France: Kirti Chemicals, 1,500 Kgs., Rs. 2,90,697.

IODINE CRUDE: From China: Atul Products Ltd., 5,400 Kgs., Rs. 16,48,508; From Japan: Prachi Pharmaceuticals Pvt. Ltd., 1,000 Kgs., Rs. 3,05,279.

IODINE: From Japan: Micron Laboratories, 1,000 Kgs., Rs. 3,06,853.

ISO BORNYL CYCLOHEXANOL: From France: Rishabh & Co., 500 Kgs., Rs. 93,629.

ISOBUTYL BENZENE: From USA: Suneeta Labs. Ltd., 13,657 Kgs., Rs. 7,19,938.

L-BASE 99%: From China: Mehta Pharmaceuticals Inds., 1,000 Kgs., Rs. 7,67,919.

L-BASE: From Hong Kong: Fine Chemicals, 500 Kgs., Rs. 3,91,434.

LITHIUM HYDROXIDE: From USA: Tide Water Oil Co. (I) Ltd., 5,000 Kgs., Rs. 3,34,943.

MONOETHYLENE GLYCOL: From Saudi Arabia: Reliance Inds. Ltd., 2,730 MTs., Rs. 5,64,01,341; From Singapore: Shree Synthetics Ltd., 75.200 MTs., Rs. 17,75,026.

MANNITOL PYROGEN: From Brazil: Hindustan Ciba Geigy Ltd., 11,250 Kgs., Rs. 3,11,574.

METHACRYLAMIDE: From Japan: PDI Chemicals Ltd., 500 Kgs., Rs. 38,553.

METHYL METHACRYLATE: From France: Dai Ichi Karkaria Ltd., 15,200 Kgs., Rs. 4,09,012; From FRG: Enerjon Technics Co. Ltd., 14,040 Kgs., Rs. 3,26,982.

2 METHYL NAPHTHALENE: From FRG: Honest Pharma Chem, 1,000 Kgs., Rs. 60,438.

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